DAV PUBLIC SCHOOL, BARIATU, RANCHI
HOLIDAY ASSIGNMENT

CLASS: XII **SUBJECT : PHYSICS**

UNIT – CURRENT ELECTRICITY

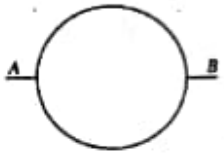
VERY SHORT ANSWER TYPE QUESTIONS [1 MARK]

(1) Two wires of equal length, one of copper and the other of manganin have the same resistance. Which wire is thicker? *(AI 2012)*

(2) Carbon and silicon both have four valence electrons each. How then are they distinguished? *(Delhi 2011C)*

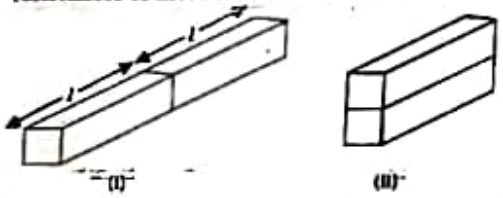
(3) Define resistivity of a conductor. Write its S.I. unit. *(AI 2011C)*

(4) A wire of resistance $8R$ is bent in the form of a circle. What is the effective resistance between the ends of a diameter AB?



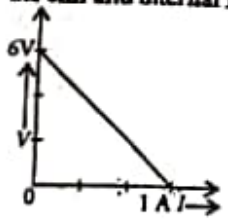
(Delhi 2010)

(5) Two identical slabs, of a given metal, are joined together, in two different ways, as shown in figures (i) and (ii). What is the ratio of the resistances of these two combinations?



(Delhi 2010C)

(6) The plot of the variation of potential difference across a combination of three identical cells in series versus current is shown below. What is the emf and internal resistance of each cell?

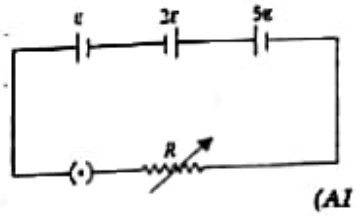


(AI 2016, Delhi 2008)

(7) The emf of a cell is always greater than its terminal voltage. Why? Give reason. *(Delhi 2013)*

(8) Why is the terminal voltage of a cell less than its emf? *(AI 2013C)*

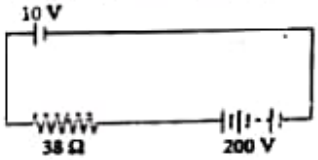
(9) Three cells of emf ε, 2ε and 5ε having internal resistances r, $2r$ and $3r$ respectively are connected across a variable resistance R as shown in the figure. Find the expression for the current. Plot a graph for variation of current with R.



(AI 2010C)

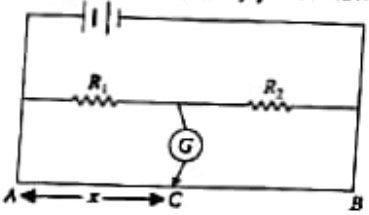
(10) Two identical cells, each of emf E, having negligible internal resistance, are connected in parallel with each other across an external resistance R. What is the current through this resistance? *(AI 2013)*

(11) A 10 V battery of negligible internal resistance is connected across a 200 V battery and a resistance of 38 Ω as shown in the figure. Find the value of the current in circuit.



(Delhi 2013)

(12) In an experiment on meter bridge, if the balancing length AC is 'x', what would be its value, when the radius of the meter bridge wire AB is doubled? Justify your answer.



(AI 2011C)

(13) In a meter bridge, two unknown resistances R and S when connected in the two gaps, give a null point at 40 cm from one end. What is the ratio of R and S? *(Delhi 2010C)*

(14) Sketch a graph showing variation of resistivity of carbon with temperature. [Delhi 2006]

(15) The variation of potential difference V with length l in case of two potentiometers P and Q is as shown. Which one of these two will you prefer for comparing emfs of two primary cells ? [AI 2006]

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16. State the underlying principle of a potentiometer. *(Delhi 2014C)*

17. A resistance R is connected across a cell of emf ε and internal resistance r. A potentiometer now measures the potential difference between the terminals of the cell as V. Write the expression for r in terms of ε, V and R. *(Delhi 2011)*

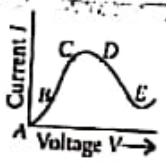
18. Define the term drift velocity of charge carriers in a conductor and write its relationship with the current flowing through it. *(Delhi 2014)*

19. Write the expression for the drift velocity of charge carriers in a conductor of length 'l' across which a potential difference 'V' is applied. *(AI 2014C)*

20. When electrons drift in a metal from lower to higher potential, does it mean that all the free electrons of the metal are moving in the same direction? *(Delhi 2012)*

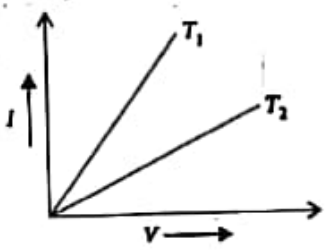
21. Two conducting wires X and Y of same diameter but different materials are joined in series across a battery. If the number density of electrons in X is twice that in Y, find the ratio of drift velocity of electrons in the two wires. *(AI 2010)*

22. Graph showing the variation of current versus voltage for a material GaAs is shown in the figure. Identify the region of



(i) negative resistance
(ii) where Ohm's law is obeyed. *(Delhi 2015)*

23. I-V graph for a metallic wire at two different temperatures, T_1 and T_2 is as shown in the figure. Which of the two temperatures is lower and why?



(AI 2015)

24. Plot a graph showing the variation of resistivity of a conductor with temperature. *(Foreign 2015)*

25. Show variation of resistivity of copper as a function of temperature in a graph. *(Delhi 2014)*

26. Plot a graph showing variation of current versus voltage for the material GaAs. *(Delhi 2014)*

27. How does one explain increase in resistivity of a metal with increase of temperature ? *(AI 2014C)*

28. Plot a graph showing the variation of resistance of a conducting wire as a function of its radius. Keeping the length of the wire and its temperature as constant. *(Foreign 2013)*

29. Two materials Si and Cu, are cooled from 300 K to 60 K. What will be the effect on their resistivity ? *(Foreign 2013)*

30. Show on a graph, the variation of resistivity with temperature for a typical semiconductor. *(Delhi 2012)*

SHORT ANSWER TYPE QUESTIONS (I) [2 MARKS]

31. A conductor of length 'l' is connected to a dc source of potential 'V'. If the length of the conductor is tripled by gradually stretching it keeping 'V' constant, how will (i) drift speed of electrons and (ii) resistance of the conductor be affected. Justify your answer. *(Foreign 2012)*

32. Define drift velocity. Write its relationship with relaxation time in terms of the electric field $\vec{E}$ applied to a conductor.
A potential difference V is applied to a conductor of length l. How is the drift velocity affected when V is doubled and l is halved ? *(Foreign 2010)*

33. Derive an expression for drift velocity of free electrons in a conductor in terms of relaxation time. *(Delhi 2009)*

34. Two metallic wires of the same material have the same length but cross-sectional area is in the ratio 1 : 2. They are connected (i) in series and (ii) in parallel. Compare the drift velocities of electrons in the two wires in both the cases (i) and (ii). *(Delhi 2008)*

35. Derive an expression for the resistivity of a good conductor, in terms of the relaxation time of electrons. *(AI 2008)*

36. (a) You are required to select a carbon resistor of resistance 47 kΩ ± 10% from a large collection. What should be the sequence of colour bands used to code it ?
(b) Write the characteristics of manganin which make it suitable for making standard resistance. *(Foreign 2011)*

37. Define ionic mobility. Write its relationship with relaxation time. How does one understand the temperature dependence of resistivity of a semiconductor ? *(Foreign 2010)*

38. The sequence of coloured bands in two carbon resistors R_1 and R_2 is
(i) brown, green, blue
(ii) orange, black, green
Find the ratio of their resistances. *(AI 2010C)*

39. A voltage of 30 V is applied across a carbon resistor with first, second and third rings of blue, black and yellow colours respectively. Calculate the value of current, in mA, through the resistor. *(AI 2007)*

40. A cylindrical metallic wire is stretched to increase its length by 5%. Calculate the percentage change in its resistance.

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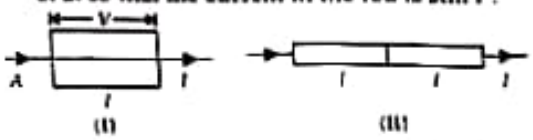
A metal rod of square cross-sectional area A having length l has current I flowing through it when a potential difference of V volt is applied across its ends (figure I). Now the rod is cut parallel to its length into two identical pieces and joined as shown in figure II. What potential difference must be maintained across the length of $2l$ so that the current in the rod is still I?



(Foreign 2016)

42. Using the concept of drift velocity of charge carriers in a conductor, deduce the relationship between current density and resistivity of the conductor. *(Delhi 2015C)*

43. Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area 1.0×10^{-7} m^2 carrying a current of 1.5 A. Assume the density of conduction electrons to be 9×10^{28} m^{-3}. *(AI 2014)*

44. Explain the term 'drift velocity' of electrons in a conductor. Hence obtain the expression for the current through a conductor in terms of 'drift velocity'. *(AI 2013)*

45. Write a relation between current and drift velocity of electrons in a conductor. Use this relation to explain how the resistance of a conductor changes with the rise in temperature. *(Delhi 2013C)*

46. Define mobility of a charge carrier. Write the relation expressing mobility in terms of relaxation time. Give its SI unit. *(AI 2013C)*

47. Given the resistances of 1 Ω, 2 Ω and 3 Ω how will you combine them to get an equivalent resistance of (i) $\frac{11}{3}$ Ω and (ii) $\frac{11}{5}$ Ω? *(Foreign 2015)*

48. A wire of 15 Ω resistance is gradually stretched to double its 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 drawn from the battery. *(AI 2009)*

49. A cell of emf 'E' and internal resistance 'r' is connected across a variable resistor 'R'. Plot a graph showing variation of terminal voltage 'V' of the cell versus the current 'I'. Using the plot, show how the emf of the cell and its internal resistance can be determined. *(AI 2014)*

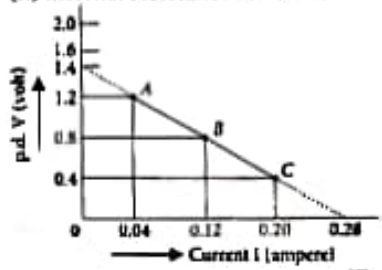
50. (a) Distinguish between emf (ε) and terminal voltage (V) of a cell having internal resistance 'r'.
(b) Draw a plot showing the variation of terminal voltage (V) vs the current (I) drawn from the cell. Using this plot, how does one determine the internal resistance of the cell? *(AI 2014C)*

51. A battery of emf E and internal resistance r when connected across an external resistance of 12 Ω, produces a current of 0.5 A. When connected across a resistance of 25 Ω, it produces a current of 0.25 A. Determine (i) the emf and (ii) the internal resistance of the cell. *(AI 2013C)*

52. A cell of emf E and internal resistance r is connected to two external resistances R_1 and R_2 and a perfect ammeter. The current in the circuit is measured in four different situations :
(i) without any external resistance in the circuit
(ii) with resistance R_1 only
(iii) with R_1 and R_2 in series combination
(iv) with R_1 and R_2 in parallel combination
The currents measured in the four cases are 0.42 A, 1.05 A, 1.4 A and 4.2 A, but not necessarily in that order. Identify the currents corresponding to the four cases mentioned above. *(Delhi 2012)*

53. A battery of emf 10 V and internal resistance 3 Ω is connected to a resistor. If the current in the circuit is 0.5 A, find
(i) The resistance of the resistor;
(ii) The terminal voltage of the battery *(Delhi 2012C)*

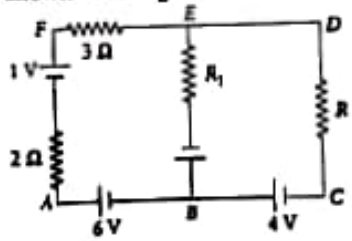
54. A straight line plot showing the terminal potential difference (V) of a cell as a function of current (I) drawn from it is shown in the figure. Using this plot, determine (i) the emf and (ii) internal resistance of the cell.



(Delhi 2011C)

55. A cell of emf 'E' and internal resistance 'r' is connected across a variable resistor 'R'. Plot a graph showing the variation of terminal potential 'V' with resistance R.
Predict from the graph the condition under which 'V' becomes equal to 'E'. *(Delhi 2009)*

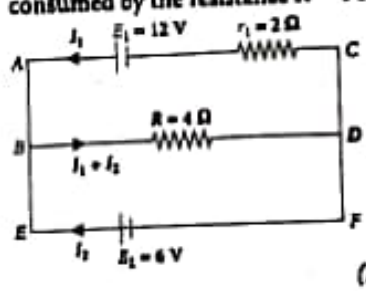
56. Use Kirchhoff's rules to determine the potential difference between the points A and D when no current flows in the BE of the electric network shown in the figure.



(AI 2015)

57. State Kirchhoff's rules. Explains briefly how these rules are justified. *(Delhi 2014)*

58. In the electric network shown in the figure, use Kirchhoff's rules to calculate the power consumed by the resistance $R = 4$ Ω.



(Delhi 2014C)

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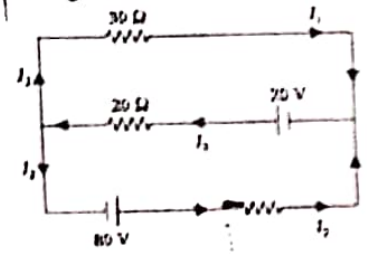
59 An ammeter of resistance 0.80 Ω can measure current up to 1.0 A.

(i) What must be the value of shunt resistance to enable the ammeter to measure current up to 5.0 A?

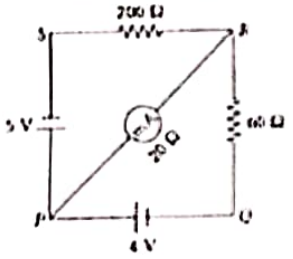
(ii) What is the combined resistance of the ammeter and the shunt? *(Delhi 2013)*

60 Use Kirchhoff's rules to determine the value of the current I_1 flowing in the circuit shown in the figure.



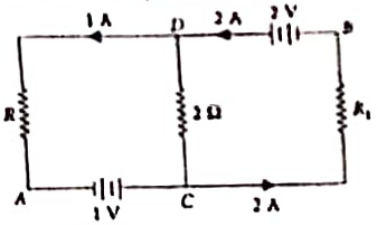
(Delhi 2013C)

61 The network *PQRS*, shown in the circuit diagram, has the batteries of 4 V and 5 V and negligible internal resistance. A milliammeter of 20 Ω resistance is connected between *P* and *R*. Calculate the reading in the milliammeter.



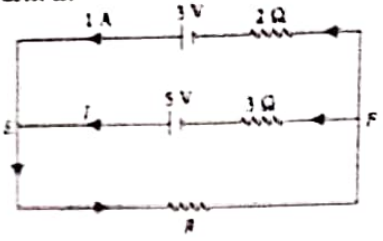
(AI 2012C)

62 In the given circuit, assuming point *A* to be at zero potential, use Kirchhoff's rules to determine the potential at point *B*.



(AI 2011)

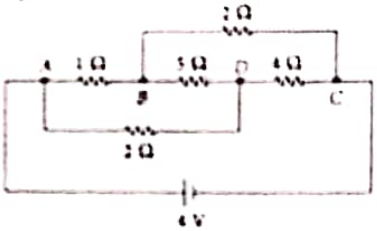
63 Using Kirchhoff's rules in the given circuit, determine (i) the voltage drop across the unknown resistor *R* and (ii) the current *I* in the arm *EF*.



(AI 2011C)

64 Use Kirchhoff's rules to obtain conditions for the balance condition in a Wheatstone bridge. *(Delhi 2015)*

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

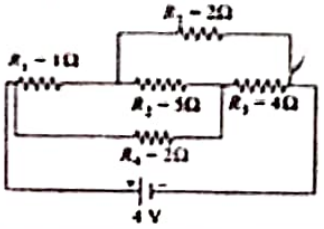


(AI 2015C)

66 Calculate the value of current drawn form a 5 V battery in the circuit as shown.

(Foreign 2013)

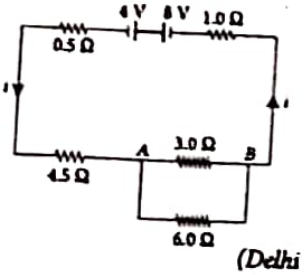
67 Calculate the current drawn from the battery in the given network.



(AI 2009)

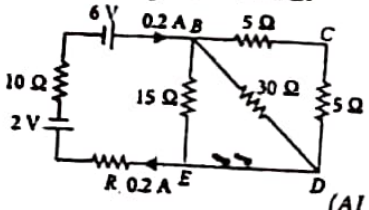
SHORT ANSWER TYPE QUESTIONS (II) [3 MARKS]

68 In the circuit shown in the figure, find the current through each resistor.



(Delhi 2015C)

69 Calculate the value of the resistance *R* in the circuit shown in the figure so that the current in the circuit is 0.2 A. What would be the potential difference between points *B* and *E*?



(AI 2012)

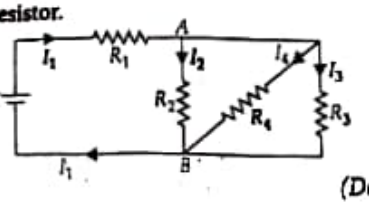
70 (a) Find the relation between drift velocity and relaxation time of charge carriers in a conductor.

(b) A conductor of length *L* is connected to a d.c. source of e.m.f. *V*. If the length of the conductor is tripled by stretching it, keeping *V* constant. Explain how drift velocity would be affected. *(AI 2015)*

71 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 ? *(Delhi 2015C)*

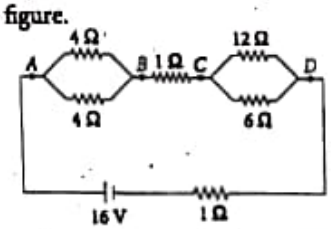
Deduce the relation between current *I* flowing through a conductor and drift velocity $\vec{v}_d$ of the electrons.

72 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.



(Delhi 2011)

73 A network of resistors is connected to a 16 V battery of internal resistance of 1 Ω as shown in the figure.



(a) Compute the equivalent resistance of the network.

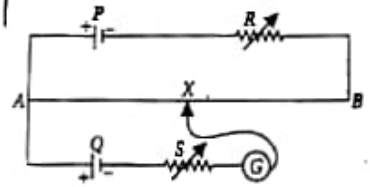
(b) Obtain the voltage drops V_{AB} and V_{CD}.

(Foreign 2010)

74 Define relaxation time of the free electrons drifting in a conductor. How is it related to the drift velocity of free electrons? Use this relation to deduce the expression for the electrical resistivity of the material. *(AI 2012)*

75 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 a metal increases and that of a semiconductor decreases with rise in temperature. *(Delhi 2007)*

76 State the underlying principle of a potentiometer. Write two factors on which the sensitivity of a potentiometer depends.

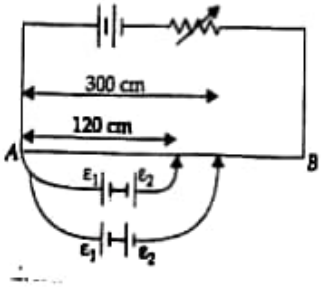


In the potentiometer circuit shown in the figure, the balance point is at *X*. State, giving reason, how the balance point is shifted when

(i) Resistance *R* is increased ?

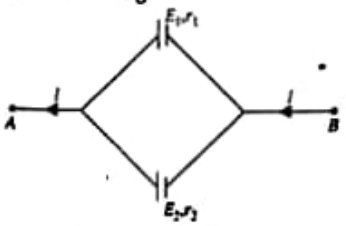
(ii) Resistance *S* is increased, keeping *R* constant ? *(Delhi 2013C)*

77 In the figure 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 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 a potentiometer increased?



(Delhi 2012)

78 Two cells of emf E_1, E_2 and internal resistance r_1 and r_2 respectively are connected in parallel as shown in the figure.



Deduct the expression for

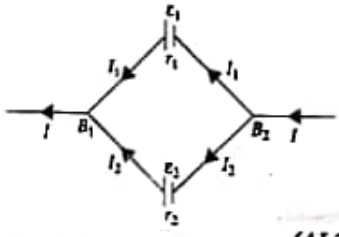
(i) The equivalent emf of the combination

(ii) The equivalent resistance of the combination

(iii) The potential difference between the points *A* and *B*. *(Foreign 2012)*

79 Two cells of emfs E_1 and E_2 and internal resistance r_1 and r_2 are connected in parallel. Obtain the expression for the emf and internal resistance of a single equivalent cell that can replace this combination ? *(Foreign 2016)*

80 Two cells of emf ε_1 and ε_2 having internal resistances r_1 and r_2 respectively are connected in parallel as shown. Deduce the expressions of the equivalent emf a cell which can replace the combination between the points B_1 and B_2.

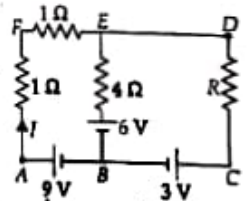


(AI 2011C)

81 A cell of emf '*E*' and internal resistance '*r*' is connected across a variable load resistor *R*. Draw the plots of the terminal voltage *V* versus (i) *R* and (ii) the current *I*.

82 It is found that when $R = 4\ \Omega$, the current is 1 A and when *R* is increased to 9 Ω, the current reduces to 0.5 A. Find the values of the emf *E* and internal resistance *r*. *(Delhi 2015)*

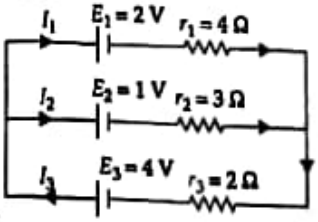
83 Using Kirchhoff's rulesdetermine the value of unknown resistance *R* in the circuit so that no current flows through 4 Ω resistance. Also find the potential difference between *A* and *D*.



(Delhi 2012)

84 (a) State Kirchhoff's rules.

(b) Use these rules to write the expressions for the currents I_1, I_2 and I_3 in the circuit diagram shown.

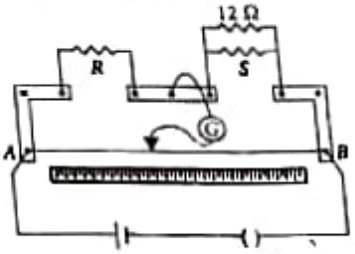


(AI 2010)

85 With the help of the circuit diagram, explain the working principle of meter bridge. How is it used to determine the unknown resistance of a given wire ? Write the necessary precautions to minimize to error in the result. *(AI 2015C)*

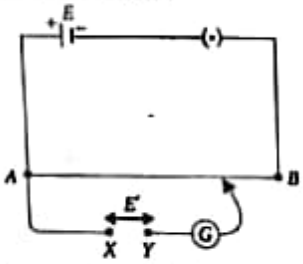
(86) Answer the following :
(a) Why are the connections between the resistors in a meter bridge made of thick copper strips?
(b) Why is it generally preferred to obtain the balance point in the middle of the metre bridge wire?
(c) Which material is used for the meter bridge wire and why? *(AI 2014)*

(87) In a meter bridge, the null points is found at a distance of 40 cm from A. If a resistance of 12 Ω is connected in parallel with S, the null point occurs at 50.0 cm from A. Determine the values of R and S.



(Delhi 2010)

(88) For the potentiometer circuit shown in the given figure, points X and Y represent the two terminals of an unknown emf E'. A student observed that when the jockey is moved form the end A to the end B of the potentiometer wire, the deflection in the galvanometer remains in the same direction. What may be the two possible faults in the circuit that could result in this observation ?

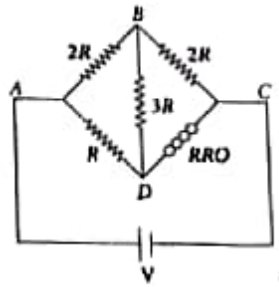


If the galvanometer deflection at the end B is (i) more, (ii) less, than that at the end A, which of the two faults, listed above, would be there in the circuit ?
Give reasons in support of your answer in each case. *(AI 2007)*

LONG ANSWER TYPE QUESTIONS [5 MARKS]

(89) (a) State, with the help of a circuit diagram, the working principle of a meter bridge. Obtain the expression used for determining the unknown resistance.
(b) What happens if the galvanometer and cell are interchanged at the balance point of the bridge ?
(c) Why is it considered important to obtain the balance point near the mid-point of the wire ? *(Delhi 2011C)*

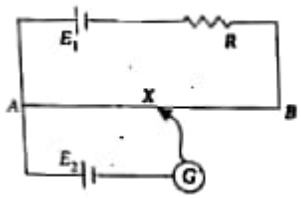
(90) Use Krichhoff's rules to obtain the balance condition in a Wheatstone bridge.
Calculate the value of R in the balance conditioncf the Wheatstone bridge, if the carbon resistor connected across the arm CD has the colour sequence red, red and orange, as is shown in the figure.
If now the resistances of the arms BC and CD are interchanged, to obtain the balance condition, another carbon resistor is connected in place of R. What would now be the sequence of colour bands of the carbon resistor ?



(Delhi 2012C)

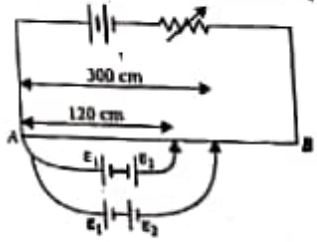
(91) (a) Derive the relation between current density 'j' and potential difference 'V' across a current carrying conductor of length 'l', area of cross-section 'A' and the number density 'n' of free electrons.
(b) Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area 1.0×10^{-7} m^2 carrying a current of 1.5 A. [Assume that the number density of conduction electrons is 9×10^{28} m^{-3}.]

(92) (i) In the circuit diagram given below, AB is a uniform wire of resistance 15 Ω and length 1 m. It is connected to a cell E_1 of emf 2V 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 end A. Calculate the value of R.



(ii) Why is potentiometer preferred over a voltmeter for comparison of emf of cells ?
(iii) Draw a circuit diagram to determine internal resistance of a cell in the laboratory.
(Foreign 2016)

(93) (a) State the principle of a potentiometer. Define potential gradient. Obtain an expression of potential gradient in terms of resistivity of the potentiometer wire.
(b) Figure shows a long potentiometer wire AB having a constant potential gradient. The null points for the two primary cells of emfs ε_1 and ε_2 connected in the manner shown are obtained at a distance of $l_1 = 120$ cm and $l_2 = 300$ cm from the end A. Determine (i) $\varepsilon_1/\varepsilon_2$ and (ii) position of null point for the cell ε_1 only.



(Foreign 2014)