

GOVIND VIDYALAYA TA MULIA

SUBJECT- PHYSICS

STD-XII

CURRENT ELECTRICITY - SA (2 marks)

- Sometimes balance point may not be obtained on the potentiometer wire. Why?
- Explain the significance of Kirchoff's law.
- Explain, with the help of graph, the variation of conductivity with temperature for a metallic conductor.
- Electrons are continuously in motion within a conductor but there is no current in it unless some source of potential is applied across its ends. Give reason.
- A current is passed through a steel wire heating it to red hot. Then half of the wire is immersed in cold water. Which half of the wire will heat up more and why?
- Using the mathematical expression for the conductivity of a material, explain how it varies with temperature for (i) semiconductor (ii) good conductors.
- A heater coil is cut into two parts and only one of them is used in the heater. What is the ratio of the heat produced by this half coil to that by the original coil?
- Is it possible that the terminal potential difference across the cell be zero? If yes, state the condition.
- A 10 m long wire of resistance 20Ω is connected in series with a battery of emf 3 V (negligible internal resistance) and a resistance of 10Ω . Find the potential gradient along the wire.

Or

A potential difference V is applied to a conductor of length l , diameter D . How are the electric field E , the drift velocity V_d and the resistance R affected when

(i) V is doubled (ii) l is doubled (iii) D is doubled

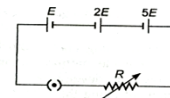
- Explain how electron mobility changes for a good conductor, when (i) the temperature of the conductor is decreased at constant potential difference and (ii) applied potential difference is doubled at constant temperature.
- A wire connected to a bulb does not glow, whereas the filament of the bulb glows when same current flows through them. Why?
- Electrons are continuously in motion within a conductor but there is no current in it unless some source of potential is applied across its ends. Give reason.
- On what factors, does the potential gradient of the potentiometer wire depend?

- A cell of emf ϵ 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 ϵ .
- Two identical heater wires are first connected in series and then in parallel. Find the ratio of heat produced in the two cases.
- Explain why an electric bulb becomes dim when an electric heater in parallel circuit is made on. Why dimness decreases after some time?

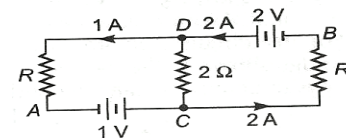
Or

Four identical cells each of emf 2 V, are joined in parallel providing supply of current to external circuit consisting of two 15Ω resistors joined in parallel. The terminal voltage of the cells as read by an ideal voltmeter is 1.6 V. Calculate the internal resistance of each cell.

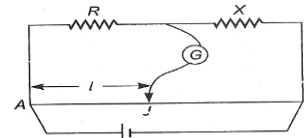
- Draw the graphs showing variation of resistivity with temperature for (i) Nichrome (ii) silicon
- What is the emf of a cell? On what factors does it depend?
- Two cells, of emf and $2E$ and E , and internal resistances $2r$ and r respectively, are connected in parallel. Obtain the expression for the equivalent emf and the internal resistance of the combination.
- Three cells of emf E , $2E$ and $5E$ having internal resistances r , $2r$ and $3r$, variable resistance R is shown in the figure. Find the expression for the current. Plot a graph for variation of current with R .



- Plot a graph showing the variation of terminal potential difference across a cell of emf ϵ and internal resistance r with current drawn from it. Using this graph, how does one determine the emf of the cell?
- In the given circuit, assuming point A to be at zero potential at point B.



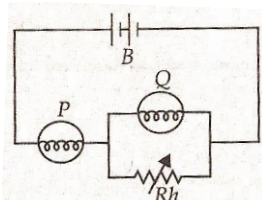
- In the meter bridge experiment, balance point was observed at J with $AJ=l$. a) The values of R and X were doubled and then interchanged. What would be the new position of balance point? b) If the galvanometer and battery are interchanged at the balanced position, how will the balance point get affected?



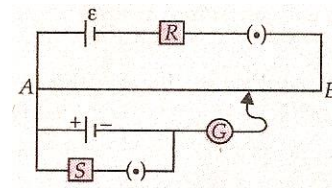
24. The sequence of coloured bands in two carbon resistor R_1 and R_2 is
 a) brown, green, blue and
 b) orange, black, green.
 Find the ratio of their resistances.
25. Derive an expression for drift velocity of free electrons in a conductor in terms of relaxation time.
26. Derive an expression for the resistivity of a good conductor, in terms of the relaxation time of electrons.
27. Derive an expression for the current density of a conductor in terms of the drift speed of electrons.
28. Write the mathematical relation between mobility and drift velocity of charge carriers in a conductor. Name the mobile charge carriers responsible for conduction of electric current in (a) an electrolyte (b) and ionized gas.

(3 marks)

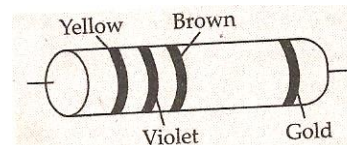
29. Define the term electrical resistivity of material. Write its SI units. Derive an expression for the resistivity of material in terms of number density and mass of free electrons present in it.
30. Define the term potential gradient. With the help of a circuit diagram, explain how a potentiometer can be used to compare the emfs of two primary cells.
31. A potential difference of V volt is applied to a conductor of length L , and diameter D . How will the drift velocity of electrons and the resistance of the conductor change when:
 (i) V is doubled
 (ii) L is halved and
 (iii) D is halved, where in each case, the other two factors remain same.
 Give reason in each case.
32. The circuit shown in the diagram contains a battery B , a rheostat R_h and identical lamps P and Q . What will happen to the brightness of the lamps, if the resistance through the rheostat is increased? Give reasons.



33. Two students X and Y perform an experiment on separate potentiometers using the circuit diagram as shown in the figure. Keeping other things unchanged
 i) X increases the value of resistance R .
 ii) Y decreases the value of resistance S in the set up.
 How would these changes affect the position of the null point in each case and why?



34. A carbon resistor has coloured strips as shown in the figure. What is its resistance?



35. Define resistivity of a conductor. Plot a graph showing the variation of resistivity with temperature for a metallic conductor. How does one explain such a behavior, using the mathematical expression of the resistivity of a material.
36. An n number of identical cells each of emf ϵ and internal resistance r connected in series are charged by a d.c. source of emf ϵ using a resistor R .
 i) Draw the circuit arrangement
 ii) Deduce the expression for
 a) the charging current
 b) the potential difference across the combination of the cells.
37. Two wires made of tinned copper having identical cross-section ($=10^{-6} \text{ m}^2$) and lengths 10cm and 15 cm are to be used as fuses. Show that the fuses will melt at the same value of current in each case.
38. A battery of e.m.f. ϵ and internal resistance r is connected across a pure resistive device of resistance R . Show that the power output of the device is maximum when the external resistance R and source internal resistance become equal. Determine this maximum power output.

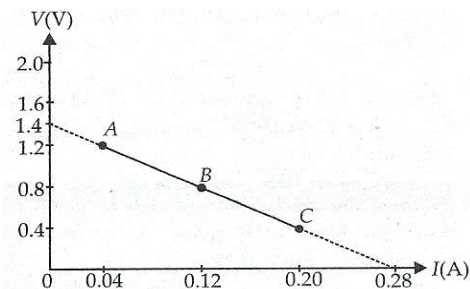
39. A fuse with a circular cross-sectional radius of 0.15mm blows at 15 A. What should be the radius of cross-section of the fuse made of the same material which will blow at 30A ?
40. A conductor of length l is connected to a d.c. source of potential V . If the length of the conductor is tripled by stretching it, keeping V constant, explain how do the following factors vary in the conductor.
- Drift speed of electrons
 - Resistance
 - Resistivity
41. Derive an expression for the drift speed of electrons in a good conductor in terms of the relaxation time of electrons.
42. 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.
43. Prove that the current density of a metallic conductor is directly proportional to the drift speed of electrons.
44. Derive the relation connecting drift speed of electrons and the electric current. Hence prove that current density is directly proportional to the relaxation time.
45. 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.
46. Derive a mathematical expression for resistivity of a conductor in terms of number density of charge of carriers in the conductor and relaxation time.
47. On what principle a meter bridge work ? Draw a circuit diagram and explain how this device can be used for determination of an unknown resistance.

(Numericals - 2 marks)

48. Two bulbs of resistance 40 ohm and 400 ohm are in series in a circuit fed with supply current. Which one will glow more? If one of these bulbs be switched off, will the light in the room increase or decrease ?
49. Four identical cells each of emf 2V, are joined in parallel providing supply of current to external circuit consisting of two 15 ohm resistors joined in

parallel. The terminal voltage of the cells as read by an ideal volt meter is 1.6 V. Calculate the internal resistance of each cell.

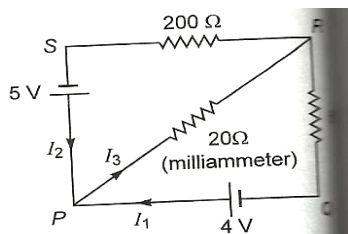
50. A battery of emf 10V and internal resistance 3 ohm is connected to a resistor R .
- If the current in the circuit is 0.5 A. Calculate the value of R .
 - What is the terminal voltage of the battery.
51. Two metallic wire A and B of the same material have the same length but cross-sectional area is in the ratio 1:2. They are connected
- In series and ii) In parallel.
- Compare the drift velocities of electrons in the two wires in both the cases i) and ii).
52. A 10m long wire of resistance 20 ohm is connected in series with battery of emf 3V (negligible internal resistance) and a resistance of 10 ohm. Find the potential gradient along the wire.
53. The potential difference across terminals of a cell were measured (in V) against different currents (In A) flowing through the cell. A graph was drawn which was a straight line ABC. Using the data given in the graph determine i) The emf and ii) The internal resistance of the cell.



54. The storage battery of a car has an emf of 12 V. If the internal resistance of the battery is 0.4 ohm. What is the maximum current that can be drawn from the battery ?
55. A battery of emf 10 V and internal resistance 3 ohm 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?
56. A storage battery of emf 8 V and internal resistance 0.5 ohm is being charged by a 120 V d.c. supply b using a series resistor of 15.5 ohm. What is the terminal voltage of the battery during charging? What is the purpose of having a series resistor in the charging circuit ?

57. Six lead acid type of secondary cell each of emf 2.0V and internal resistance 0.015 ohm are joined in series to provide a supply to a resistance of 8.5 ohm. What are the current drawn from the supply and its terminal voltage ?
58. In a potentiometer arrangement, a cell of emf 1.25V give a balance point at 35cm length of wire. If the cell is replaced by another cell and the balance point shifts to 63cm. what is the emf of the second cell ?
59. A voltage of 30V is applied across a carbon resistor with 1st, 2nd & 3rd rings of blue, black and yellow colour respectively. Calculate the value of current mA, through the resistor.
60. Calculate the temperature at which the resistance of a conductor become 20% more than its resistance at 27°C. The value of temperature coefficient of resistance of the conductor is $2.0 \times 10^{-4}/K$.
61. A battery of emf ϵ and internal resistance r gives a resistance of 0.5 with an external resistance of 12 ohm and a current of 0.25A with an external resistance of 25 ohm. Calculate i) Internal resistance of the cell and ii) emf of the cell.

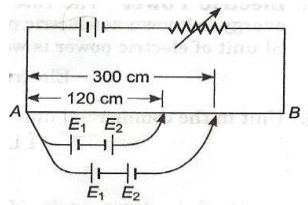
62. State Kirchoff's rules. Apply these rules to the loops PRSP and PRQP to write the expressions for the currents I_1 , I_2 and I_3 in the given circuit.



55.

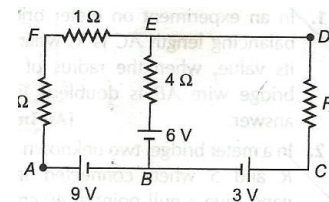
(3 marks)

63. 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 emf E_1 and E_2 connected in the manner shown, are

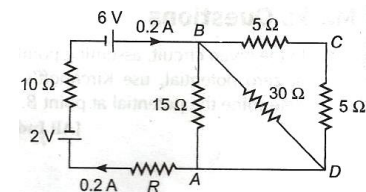


- obtained at a distance of 120 cm and 300 cm from the end A. Find (a) E_1/E_2 and (b) position of null point for the cell E_1 . How is the sensitivity of a potentiometer increased ?

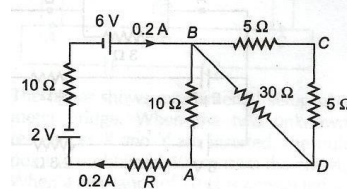
64. Using Kirchoff's rules, determine the value of unknown resistance R in the circuit so that no current flows through 4Ω resistance. Also, find the potential difference between points A and D.



65. 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 A and B.

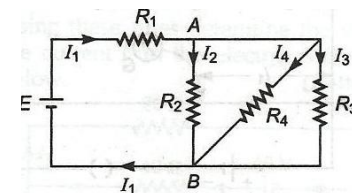


66. Calculate the value if the resistance R in the circuit shown in the figure so that the current in the circuit is 0.2 A. (What would be the potential difference between points A and D ?)

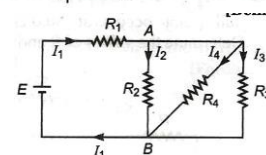


67. Two heating elements of resistance R_1 and R_2 when operated at a constant supply of voltage, consume powers P_1 and P_2 respectively. Deduce the expression for the power of their combination when they are, connected in (a) series and (b) parallel across their same voltage supply.
68. In the circuit shown, $R_1 = 4\Omega$, $R_2 = R_3 = 15\Omega$, $R_4 = 30\Omega$ and $E = 10\text{ V}$. Calculate the equivalent resistance of the circuit and the current in each resistor.

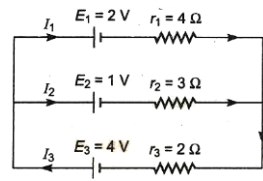
69. In the circuit shown, $R_1 = 4\Omega$, $R_2 = R_3 = 5\Omega$, $R_4 = 10\Omega$ and $E = 6\text{ V}$. Work out the equivalent resistance of the circuit and the current in each resistor.



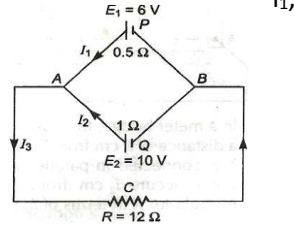
70. In the circuit shown, $R_1 = 2\Omega$, $R_2 = R_3 = 10\Omega$, $R_4 = 20\Omega$ and $E = 6\text{ V}$. Work out the equivalent resistance of the circuit and the current in each resistor.



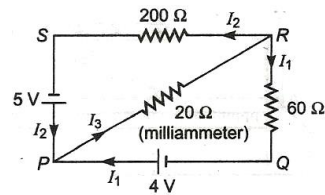
71. State Kirchhoff's rules. Use these rules to write the expressions for the currents I_1 , I_2 and I_3 in the circuit diagram shown.



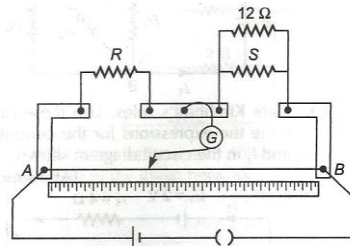
72. State Kirchhoff's rules. Apply Kirchhoff's rules to the loops ACBPA and ACBQA to write the expression for the currents I_1 , I_2 , and I_3 in the network.



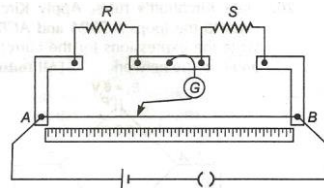
73. State Kirchhoff's rules. Apply these rules to the loops PRSP and PRQP to write the expressions for the currents I_1 , I_2 and I_3 in given circuit.



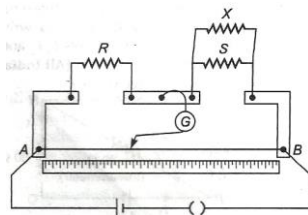
74. In a meter bridge, the null point is found at a distance of 40cm from A. If a resistance of $12\ \Omega$ is connected in parallel with S, the null point occurs at 50.0cm from A. Determine the values of R and S.



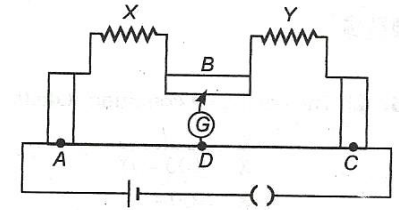
75. In a meter bridge, the null point is found at a distance of 60 cm from A. If a resistance of $5\ \Omega$ is connected in series with S, the null point occurs at 50.0 cm from A. Determine the values of R and S.



76. In a meter bridge, the null point is found at a distance of l_1 cm from A. If a resistance of X is connected in parallel with S, the null point occurs l_2 cm from A. Obtain the formula for X in terms of l_1 , l_2 and S.

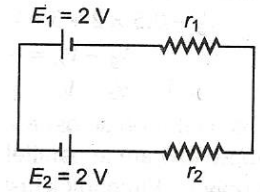


77. The figure shows experimental setup of a meter bridge. When the two unknown resistances X and Y are inserted, the null point D is obtained 40cm from the end A. When a resistance of $10\ \Omega$ is

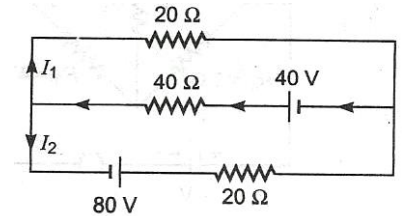


- When a resistance of $10\ \Omega$ is connected in series with X, the null point shifts by 10cm. Find the position of the null point when the $10\ \Omega$ resistance is instead connected in series with resistance Y. Determine the values of the resistances X and Y.

78. State Kirchhoff's rules. Use Kirchhoff's rules to show that no current flows in the given circuit.



79. State Kirchhoff's rules of current distribution in an electrical network. Using these rules determine the value of the current I_1 in the electric circuit given below.



(5 marks)

80. Draw the circuit diagram of potentiometer which can be used to determine the internal resistance (r) of a given cell of emf (ϵ). With the help of this diagram describe the method to find the internal resistance of the primary cell.

81. A cell of unknown emf ϵ and internal resistance r , two unknown resistances R_1 , and R_2 and $R_2(R_2 > R_1)$ and a perfect ammeter are given. The current in the circuit is measured in five different situations.

- Without any external resistance in the circuit,
- With resistance R_1 only,
- With resistance R_2 only,
- With both R_1 and R_2 used in series combination,
- With both R_1 and R_2 used in parallel combination.

The current obtained in the five cases are 0.42A, but not necessarily in that order. Identify the currents in the five cases listed above and calculate ϵ , r , R_1 and R_2 .

82. Using the concept of drift velocity, derive Ohm's law.
83. Prove that the current density of a metallic conductor is directly proportional to the drift speed of electrons.
84. Derive condition of balance of a Wheatstone bridge.
85. Discuss the variation of resistivity with temperature in case of (i) metals (ii) alloys and (iii) semiconductors.
86. Draw the circuit diagram of potentiometer which can be used to determine the internal resistance (r) of a given cell of emf (ϵ). With the help of this diagram describe the method to find the internal resistance of the primary cell.
87. Find the conditions for maximum current in the external resistor R when number of cells each of emf ϵ and internal resistance r are connected (i) in series (ii) in parallel and (iii) in mixed grouping.
88. Using the concept of drift velocity, derive, Ohm's law.

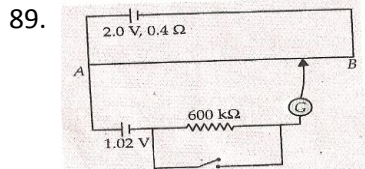


Fig. shows a potentiometer with a cell of 2.0V and internal resistance 0.45Ω maintaining a potential drop across the resistor wire AB. A standard cell which maintains a constant emf of 1.02V (for very moderate currents upto a few mA) gives a balance point at 67.3cm length of the wire. To ensure very low currents drawn from the standard cell, a very high resistance of $600k\Omega$ is put in series with it, which is shorted close to the balance point. The standard cell is then replaced by a cell of unknown emf ϵ and the balance point found similarly, turns out to be at 82.3 cm length of the wire.

- (a) What is the value ?
- (b) What purpose does the high resistance of $600k\Omega$ have ?
- (c) Is the balance point affected by this high resistance ?
- (d) Is the balance point affected by the internal resistance of the driver cell ?
- (e) Would the circuit work well for determining an extremely 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 ?
90. Using Kirchhoff's laws, find the relation between the resistance of four arms of a Wheatstone bridge when the bridge is balanced. Draw a circuit

diagram to determine the unknown resistance of a metallic conductor using a meter bridge.

91. Find the conditions for maximum current in the external resistor R when number of cells each of emf ϵ and internal resistance r are connected (i) in series (ii) in parallel and (iii) in mixed grouping.

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