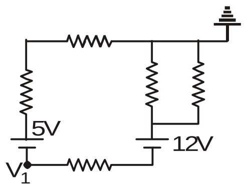
15. CURRENT ELECTRICITY

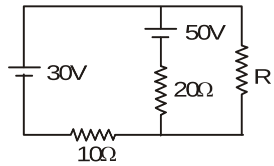
SECTION - I : STRAIGHT OBJECTIVE TYPE

15.1 In the circuit shown, each resistances is 2 Ω. The potential V_1 as indicated in the circuit, is equal to



(A) 11 V (B) – 11 V (C) 9 V (D) – 9 V

15.2 In the circuit shown, the value of R in ohm that will result in no current



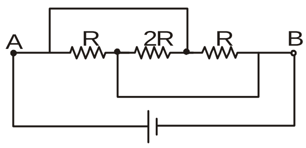
(A) 10 Ω (B) 25 Ω

(C) 30 Ω (D) 40 Ω

15.3 The maximum current in a galvanometer can be 10 mA. It's resistance is 10Ω. To convert it into an ammeter of 1 Amp. a resistor should be connected in
(A) series, 0.1Ω (B) parallel, 0.1Ω (C) series, 100Ω (D) parallel, 100Ω.

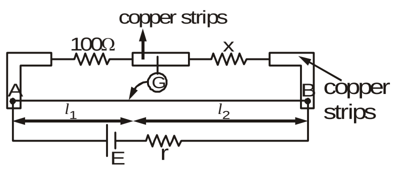
15.4 When agalvanometer is shunted with a 4Ω resistance, the deflection is reduced to one - fifth. If the galvanometer is further shunted with a 2Ω wire, the further reduction (find the ratio of decrease in current to the previous current in) in the deflection will be (the main current remains the same).
(A) (8/13) of the deflection when shunted with 4Ω only
(B) (5/13) of the deflection when shunted with 4Ω only
(C) (3/4) of the deflection when shunted with 4Ω only
(D) (3/13) of the deflection when shunted with 4Ω only

15.5 In the figure shown the current flowing through 2 R is :



(A) from left to right (B) from right to left
(C) no current (D) None of these

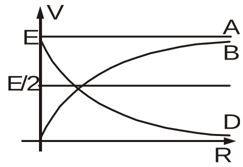
15.6 In a practical wheat stone bridge circuit as shown, when one more resistance of 100W is connected is parallel with unknown resistance ' x ' , then ratio l1ll2 become ' 2 ' . l1 is balance length. AB is a uniform wire. Then value of ' x ' must be:



(A) 50 Ω (B) 100 Ω (C) 200 Ω (D) 400 Ω

15.7 A battery of internal resistance 2Ω is connected to a variable resistor whose value can vary from 4Ω to 10Ω. The resistance is initially set at 4Ω. If theresistance is now increased then
(A) power consumed by it will decrease
(B) power consumed by it will decrease
(C) power consumed by it may increase or may decrease
(D) power consumed will first increase then decrease.

15.8 A cell of emf E having an internal resistance ' r ' is connected to an external resistance R. The potential difference ' v ' across the resistance R varies with R as shown by the curve:

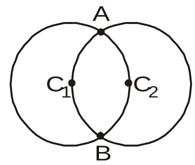


(A) A (B) B (C) C (D) D

15.9 ' n ' identical light bulbs, each designed to draw P power from a certain voltage supply are joined in series and that combination i connected across that supply. The power consumed by one bulb will be-
(A) n P (B) P (C) P/n (D) P/n^2

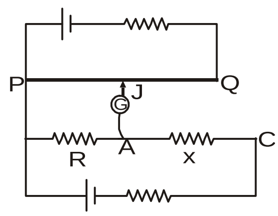
15.10 To get maximum current through a resistance of 2.5 Ω, one can use ' m ' rows of cells, each row having ' n ' cells. The internal resistance of each cell is 0.5 Ω. What are the values of n & m, if the total number of cells is 45.
(A) 3, 15 (B) 5, 9 (C) 9, 5 (D) 15, 3

15.11 Two circular ring of identical radii and resistance of 36W each are placed in such a way that they cros each other's centre C1 and C12 as shown in figure. Conducting joints are made at intersectionpoints A and B of the rings. An ideal cell of emf 20Volts is connected across AB. The power delivered by cell is



(A) 80 watt (B) 100 watt (C) 120 watt (D) 200 watt

15.12 Circuit for the measurement of resistance by potentiometer is shown. The galvanometer is first connected at point A and zero deflection is observed at length P J = 10 cm. In second case it is connect at point C and zere deflection is observed at a length 30cm from P. Then the unknown reitance X is



(A) 2R (B) $\frac{R}{2}$ (C) $\frac{R}{3}$ (D) 3R

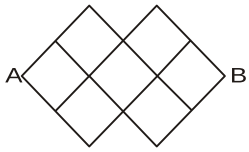
15.13 Two long coaxial and conducting cylinders of radius a and b are seperated by a material of conductibity and a constant potential difference V i maintained between them, by a battery. Then the current, per unit length of the cylinder flowing from one cylinder the other is:

(A) $\frac{3\pi}{4}$ (B) $\frac{\pi}{4}$ (C) $\frac{\pi}{3}$ (D) None of these

15.14 50 V battery is upplyihng current of 10amp when connected to a resistor. If the efficiencyh of battery at this current is 25%. Then internal resistance of battery is :
(A) 2.5 Ω (B) 3.75 Ω (C) 1.25 Ω (D) 5 Ω

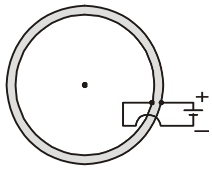
15.15 A battery is suppling power to a tape-recorder by cable of resistance of 0.02 Ω. If the battery is generating 50W power at 5V, then power received by tape-recorder is :
(A) 50 W (B) 45 W (C) 30 W (D) 48 W

15.16 In the shown wire frame, each side of a square (the smallest square) has a resistance R. The equivalent resistance of the circuit between the points A and B is :



(A) R (B) 2R (C) 4R (D) 8R

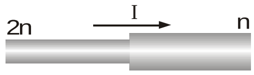
15.17 A spherical shell, made of material of electrical conductivity , has thicknesss t = 2 mm and radius R = 10cm. In an arrangement, its inside surface is kept at a lower potential than its outside surface.



The resistance offered by the shell is equal to -

(A) $5\pi \times 10^{-12}\Omega$ (B) $2.5 \times 10^{-1}1\Omega$ (C) $5 \times 10^{-12}\Omega$ (D) $5 \times 10^{-1}1\Omega$

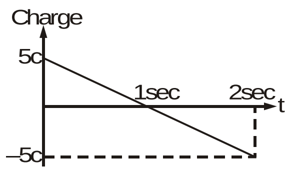
15.18 Two cylindrical rods of uniform cross-section area A and 2A, having free electrons per unit volume 2n and n respectively are joined in series. A current I flows through them in steady state. Then the ratio of drift velocity of free electron in left rod to drift velocity of electron in the right rod is

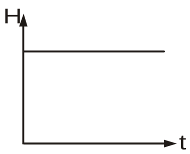


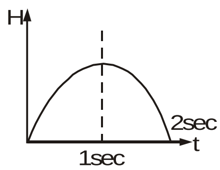
(A) $\sin\left(\tan^{-1}3 + \tan^{-1}\frac{1}{3}\right)$ (B) 1

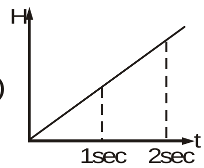
(C) 2 (D) 4

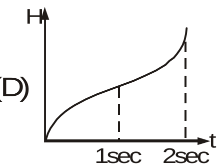
15.19 A charge pasing through a resistor is varying with time ass hown kin the figure. The amount of heat generated in time ' t ' is best represented (as a function of time) by:



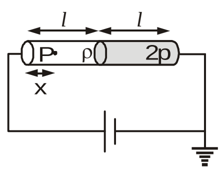
(A)


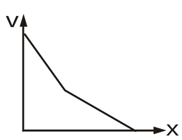
(B)


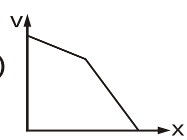
(C)


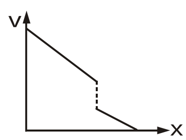
(D)


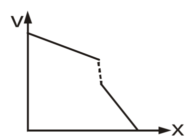
15.20 Two cylindrical rods of same cross-section area and same loength are connected in sseries to an ideal cell as shown. The resistivity of left rod is p and that of right rod is 2p. Then the variation of potential at any point P distant x from left end of combined rod system is given by.



(A)


(B)


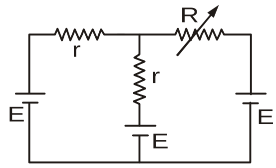
(C)


(D)


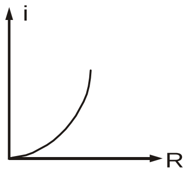
15.21 A copper sphere of 10cm diameter is lowered is lowered into a water filled hemispherical copper vessel of 20 cm diameter so that the sphere and the vessel becomes concentric. Electrical conductivity of water is $\sigma = 10^{-3}$ S/m. The electrical resistance between the sphere and the vessel is :

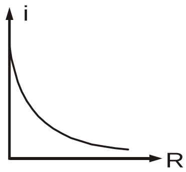
(A) 1591.6Ω (B) 1450Ω (C) 1642.4Ω (D) 1489.6Ω

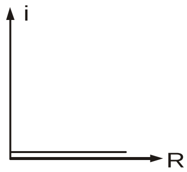
15.22 In the shown circuit the resistance R can be varied :

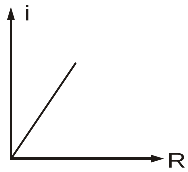


The variation of current through R against R is correctly plotted as :

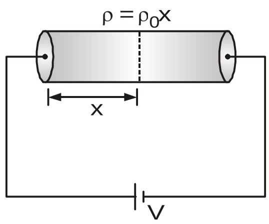
(A) 

(B) 

(C) 

(D) 

15.23 A cylindrical solid of length L and radius a is having varying resistivity given by $\rho = \rho_0 x$ where ρ_0 is a poitive constant and x is measured from left end of solid. The cell shown in the figure is having emf V and negligible internal resistance. The electric field as a function of x is best described by :



(A) $\frac{2V}{L^2} \times X$

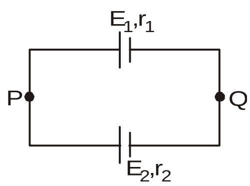
(B) $\frac{2V}{\rho_0 L^2} \times X$

(C) $\frac{V}{L^2} \times X$

(D) None of these

SECTION-II : MULTIPLE CORRECT ANSWER TYPE

15.24 Two cells of unequal emfs E_1 and E_2 and internal resistances r_1 and r_2 are joined as shown in figure. V_p and V_Q are the potential at P and Q respectively.



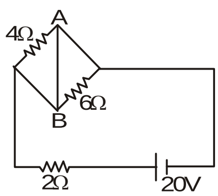
(A) The potential difference across both the cells will be equal

(B) One of the cell, will supply energy to the other cell.

(C) The potential difference across one of the cells will be greater than its emf.

(D) $V_p - V_Q =$

15.25 In the circuit shown in figure



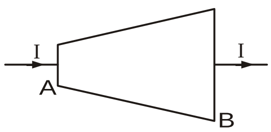
(A) power supplied by the battery is 200 watt

(B) current flowing in the circuit is 5 A

(C) potential difference across 4Ω resistance is equal to the potential difference across 6Ω resistance

(D) current in wire AB is zero

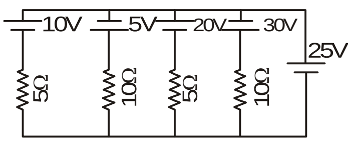
15.26 In the figure a conductor of non-uniform cross-section is shown. A steady current I flows in it.



(A) The electric field at A is more than at B.

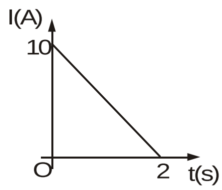
(B) The electric field at B is more than at A.
(C) The thermal power generated at A is more than at B in an element of small same width.
(D) The thermal power generated at B i more than at A in an element of small same width.

15.27 In the figure shown: (All batteries are ideal)
(A) current through 25 V cell is 20 A
(B) current through 25V cell is 12.5 A
(C) power supplied by 20 V cell is 20 W
(D) power supplied by 20 V cell is – 20 W

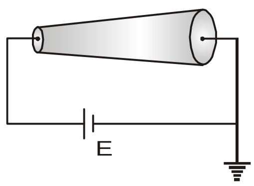


15.28 Consider a resistor of uniform cross section area connected to a battery of internal resistence zero. If the length of the resistor is doubled by stretching it then
(A) current will become four times.
(B) the electric field in the wire will become half
(C) the thermal power produced by the resistor will become one fourth.
(D) the product of the current density and conductance will become half.

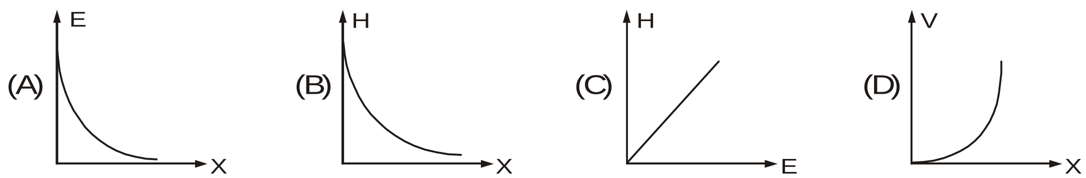
15.29 A variable current flows through at 1Ω resistor for 2 seconds. Time dependence of the current is shown in the graph.
(A) Total charge flown through the resistor is 10C.
(B) Average current throught the resistor is 5A.
(C) Total heat produced in the resistor is 50 J.
(D) Maximum power during the flow of current is 100 W.



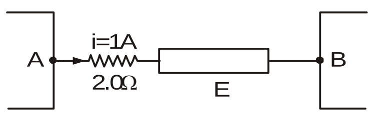
15.30 A conductor of truncted conical (frustum) is connected to a battery of emf E as shown in figure.



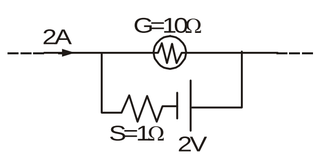
If at a section distant x from left end, electric field intensity, potential and rate of generation of heat per unit length are E, V and H respectively, then which of the following graph(s) is/are correct ?



15.31 AB is part of a circuit as shown, that absorbs energy at a rate of 50W. E is an emf device that has no internal resistance.
(A) Potential difference across AB i 48V.
(B) Emf of the device is 48V.
(C) Point B is connected to the positive terminal of E
(D) Rate of conversion from electrical to chemical energy is 48 W in device E.



15.32 The galvanometer shown in the figure hass resistance 10Ω. It is hunted by a eries combination of aresistance S = 1Ω and an ideal cell of enf 2V. A current 2A passes as shown. -
(A) The reading of the galvanometer is 1A
(B) The reading of the galvanometer is zero
(C) The potential difference actoss the resistance S is 1.5V
(D) The potential difference acress the resistance S is 2V



SECTION -III : ASSERTION AND REASON TYPE

15.33 **STATEMENT**-1: When an external resistor of resistance R (connected across a cell of internal resistance r) is varied, power consumed by resistance R is maximum when R = r.

STATEMENT-2: Power consumed bya resistor of constant resistance R is maximum when current through it is maximum.

(A) Statement-1 is True, Statement-2 is True; Statement-2is a correct explanation for LStatement-1.

(B) Statement-1 is True,Statement-2 is True; Statement-2 is NOT a corrent explantion for Statement-1

(C) Statement-1is True, Statement-2 is Fale

(D) Statement-1is Flase, Statement-2 is True.

15.34 **TATEMENT-1:** The current density $\vec{j}$ at any point in ohmic resistor is in direction of electric field $\vec{E}$ at that point.

STATEMENT-2: A point charge when released from rest in a region having only electrostatic field alwaysmoves along electric lines of force.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct a explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

15.35 **STATEMENT-1 :** A wire of uniform cross ection and uniform resitivity is connected across an ideal cell. Bow the length of the wire is doubled keeping volume of wire constant. The drift velocity kof electrons after stretchintg the wire becomes one fourth of what it wa before stretching the wire.

STATEMENT-2 : If a wire (of uniform resitivity and uniform cross-section) of length l_o is stretched to length nl_o, then its resistance becomes n^2 times of what it was before stretching the wire(the volume of wire is kept constat in stretching process). Further at constant potential difference, current is inversely proportional to resistance. Finally drift velocity kof free electron is directly proportional to current and inversely proportional to cross section area of curent carrying wire..

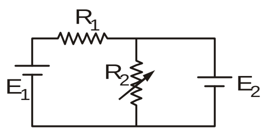
(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct a explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

15.36 **STATEMENT-1 :** IN the circuit shown both cells are ideal and of fixed emf, the resistor of resistance R_1 has fixed resistance and the resistance of resistor R_2 can be varied(but R_2 is always non-zero). Then the electric power delivered to resistor of resistance R_1 i independent of value of resistance R_2.



STATEMENT-2 : If potential difference across a fixed resistance is unchanged, the power delivered to the resistor remains constant.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct a explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

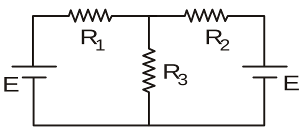
(D) Statement-1 is False, Statement-2 is True

15.37 **Statement-1:** The power delivered to a light bulb is more just after it is switched ON and the glow of the filament is increasing, as compared to when the bulb is glowing steadily, i.e., after some time of switching ON.

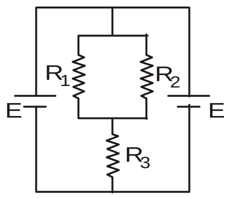
Statement-2: As temperature increases, resistance of conductor increases.

(A) Statement-1 is True,LStatement-2 is True, Statement-2 **is** a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True.

15.38 **STATEMENT-1:** For calculation of current in resistors of resistance R_1, R_2 and R_3 in the circuit shown in figure 1, the circuit can be redrawn as shown in figure 2 (this means that circuit shown in figure 2 is equivalent to circuit shown in figure 1). All the cells shown are ideal and identical.



(fig.1)



(fig.2)

STATEMENT-2: Whenever potential difference across two resistors is same, both resistors can be assumed as a combination of two resistorss in parallel.

(A) Statement-1 is True,LStatement-2 is True, Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

SECTION-IV: COMPREHENSION TYPE

Comprehenion # 1

Resistance value of an unknown resistor is calculated using the formula $R = \frac{V}{I}$ where V and I be the readings of the voltmeter and the ammeter respectively. Consider the circuits below. The internal resistances of the voltmeter and the ammeter (R_V and R_G respectively) are finite and non zero.

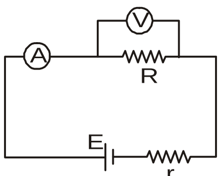


Figure (A)

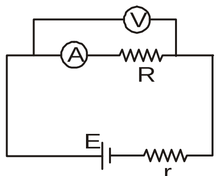


Figure (A)

Let R_A and R_N be the calculated values in the two caes A and B respectively.

15.39 THe relation between RA and the actual value R is
(A) $R > R_A$ (B) $R > R_A$ (C) $R = R_A$ (D) dependent upon E and r.

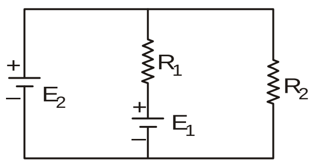
15.40 THe relation between RA and the actual value R is
(A) $R < R_B$ (B) $R < R_B$ (C) $R = R_B$ (D) dependent upon E and r.

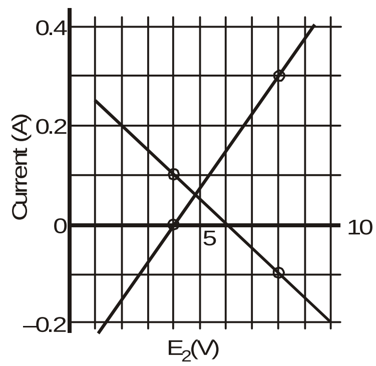
15.41 If the resistance of voltmeter is $R_V = 1\ k\ \Omega$ and that of ammeter is $R_G = 1\ \Omega$, the magnitude of the percentage error in the measurement of R(the value of R is nearly 10Ω) is:

(A) zero in both cases (B) non zero but equal in both cases
(D) more in circuit A (D) more in circuit B

Comprehension #2

In the circuit given below, both batteries are ideal, EMF E_1 of battery 1has a fixed value, but emf E_2 of battery 2 can be varied betwen 1.0V and 10.0V. The graph gives the curents through the two batteries as a function of E_2' but are not marked as which plot corresponds to which battery. But for both plots, current is assumed to be negative when the direction of the current though the battery is opposite the direction of that battery's emf. (direction of emf is from negative to positive)





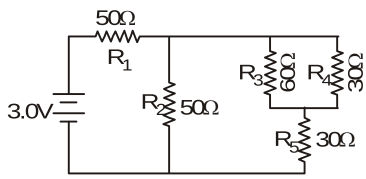
15.42 The value of emf E_1 is
(A) 8 V (B) 6 V (C) 4 V (D) 2V

15.43 The resistance R_1 has value
(A) 10 Ω (B) 20 Ω (C) 30 Ω (D) 40 Ω

15.44 The resistance R_2 is equal to :
(A) 10 Ω (B) 20 Ω (C) 30 Ω (D) 40 Ω

Comprehension

In the circuit shown, the resisstances are given in ohms and the battery is asumed ideal with emf equal to 3.0 volts.



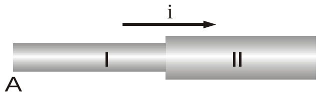
15.45 The resistor that dissipates maximum power.
(A) R_1 (B) R_2 (C) R_4 (D) R_5

15.46 The potential difference across resistor R3 is
(A) 0.4 V (B) 0.6 V (C) 1.2 V (D) 1.5 V

15.47 The curent passing through 3V battery is
(A) 10 mA (B) 30 mA (C) 40 mA (D) 60 mA

SECTION-V : MATRIX-MATCH TYPE

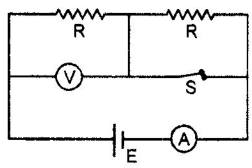
15.48 Column I gives physical quantities of a situation in which a current i passes through two rods I and II of equal legth that are joined in series. The ratio of free electron density (n, resistivity (p) and cross- section area (A) of both are in ratio $n_1 : n_2 = 2 : 1$, $p_1 : p_2 : = 2 : 1$ and $A_1 : A_2 = 1 : 2$ respectively. Column II gives corresponding results. Match the rations in column I with the values in Column II.



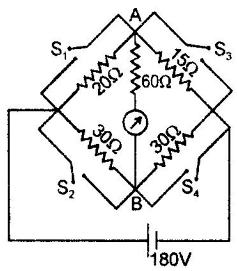
Columnn I	Column II
(A) $\dfrac{\text{Drift velocity of free electron in rod I}}{\text{Drift velocity of free electron in rod II}}$	(p) 0.5
(B) $\dfrac{\text{Electric field in rod I}}{\text{Electric field in rod II}}$	(q) 1
(C) $\dfrac{\text{Potential difference across rod I}}{\text{Potential difference across rod II}}$	(r) 2
(D) $\dfrac{\text{Average time taken by free electron to move from A to B}}{\text{Average time taken by free electron to move from B to C}}$	(s) 4

15.49 In the circuit shown, batery, ammeter and voltmeter are ideal and the switch S is initially closed as shown. When switch S is opened, match the parmeter of column I with the effects in column II.

Columnn I	Column II
(A) Equivalent resistance across the battery,	(p) Remains same
(B) Power dissipated by left resistance R	(q) Increases
(C) Voltmeter reading	(r) decreases
(D) Ammeter reading	(s) Becomes zero.



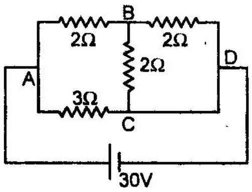
15.50 Consider the circuit shown. The resistance connected between the junction A and B is 60 Ω including the resistance of the galvanometer. The switches have no resistance when shorted and infinite resistance when opened. All the switchess are initially kopen and they are closed as given in column I. Match the condition in column I with the direction of current through galvanometer and the value of the current through the batery in column II.

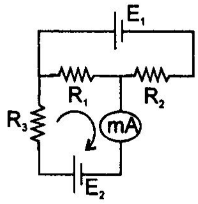


Column I	Column II
(A) Only switch S_1 is closed	(p) Current from A to B
(A) Only switch S_2 is closed	(q) Current from B to A
(A) Only switch S_3 is closed	(r) current through the battery is12.0A
(A) Only switch S_4 is closed	(s) Crrent through the batery is 15.6 A
	(t) Current throuth the Galvanometer is 1.2 A

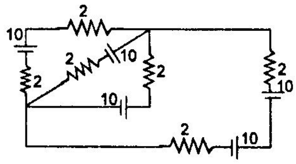
SECTION- VI : SSUBJECTIVE ANSWER TYPE
SHORT SUBJECTIVE

15.51 Find current in the branch CD of the circuit (in ampere).



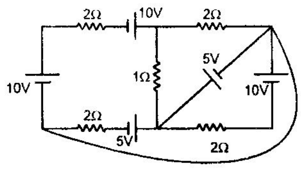


15.52 The circuit hown in the figure contains three resistors R_1 = 100 Ω, R_2 = 50Ω & R_3 = 20Ω and cells of emf's E_1 = 2V & E_2. The ammeter indicates a current of 50mA. Determine the current in the reistor and the emf of the econd cell. The internal resistance of the ammeter and of the cell should be neglected.



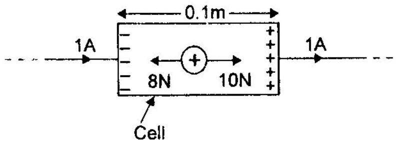
15.53 All batteries are having emf 10 volt and internal resistance negligible. All resistors are in ohms. Calculate the current in the right most 2Ω resistor.

15.54 In the circuit diagram shown find the current through the 1Ω resistor.



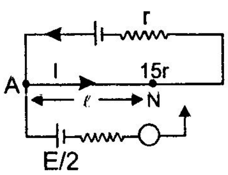
15.55 The efficiency of a cell when connected to a resistance R is 60%. kWhat will be its efficiency if the external resistance is increased to six times.

15.56 Figure shows a cell in which unit positive charge experience a constant non electric force of 10N and a constant electric force of 8N in directions shown in the figure. Find the emf of the cell,the potential difference across the cell and the internal resistance of the cell.

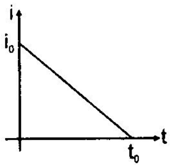


LONG SUBJECTIVE

15.57 Consider the potentioneter circuit arranged as in figure. The potentiometer wire is 600 cm long. (a) At what distance from the point A should the jockey touch the wire to get zero deflection in the galvanometer ? (b) If the jocky touches the wire at a distance of 560 cm from A, what will be jthe curent inthe galvanometer?



15.58 Relation between current in conductor and time is shown in figure then determine.
(a) Total charge flow through the conductor
(b) Write expression of current in terms of time
(c) If resistance of conductor i R then total heat dissipated across resistance R is



(a) Total charge flow through the conductor
(b) Write expression of current in terms of time
(c) If resistance of conductor is R then total heat dissipated across resistance R is

15.59 In the circuit shown all five resistors have the same value 200 ohms and each cell has an emf 3 volts. Find the open circuit voltage and the short circuit current for the terminals A and B.