RAVI MATHS TUITION CENTER , CHENNAI- 82. WHATSAPP - 8056206308

Current Electricity

12th Standard

Physics

88 x 1 = 88

1) When a current I is set up in a wire of radius r, the drift speed id v_d. If the same current is set up through a wire of radius 2r the drift speed will be

(a) $v_d/4$ (b) $v_d/2$ (c) $2v_d$ (d) $4v_d$

2) The equivalent resistance of n resistors each of same resistance when connected in parallel is R_p. If they are connected in series, the equivalent resistance will be:

(a) R_p/n^2 (b) R_p/n (c) nR_p **(d) n^2R_p**

3) Two resistance when connected in parallel have equivalent resistance of 3Ω. When one of the resistance is burnt and broken, the net resistance is 12Ω. What is the resistance of the burnt resistor?

(a) 4Ω (b) 8Ω (c) 12Ω (d) 16Ω

4) Three equal resistors each of resistance R are connected so as to form a triangle. The equivalent resistance across any two corners is:

(a) 2R/3 (b) R/3 (c) 3R/2 (d) 3R

5) Four wires each of same length, diameter and material are connected to each other to form a square. If the resistance of each wire is R, then equivalent resistance across the opposite corners is:

(a) R/4 (b) R/2 (c) R **(d) none of the above**

6) What is the resistance across A and B in the fig

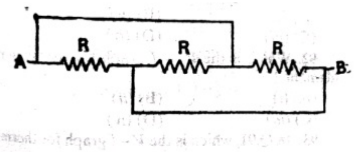


Fig. Q-82.1

(a) 3R (b) R **(c) R/3** (d) None of the above

7) What is the resistance across A and B in the fig?

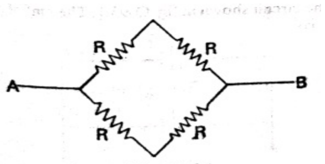


Fig. Q-83.1

(a) $\frac{R}{2}$ **(b) R** (c) 2R (d) 4R

8) What is the resistance between A and B in the fig.

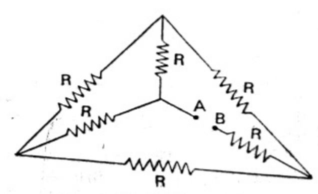


Fig. Q-85.1

(a) R/2 (b) R **(c) 2R** (d) 3R

9) What is the resistance across A and B in the fig.?

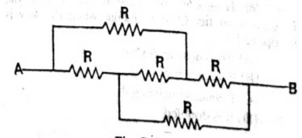


Fig. Q-86.1

(a) R/5 (b) R/3 **(c) R** (d) 3R

10) According to the Kirchhoff's law the sum of the products of current and resistance as well as emfs in a closed loop is:

(a) greater than zero **(b) zero** (c) less than zero (d) determained by the emf

11) Why the wheatstone bridge is more accurate than the other methods of measuring resistance?

(a) It has four resistor arms (b) It is based on Kirchhoff's laws (c) It does not involve ohm's law **(d) It is a null method**

12) For higher sensitivity which of the following is essential for the potentiometer?

(a) Higher emf of quxiliary battery (b) Higher resistivity of the wire **(c) Larger length of the wire** (d) None of the above

13) Resistivity of a conductor depends upon its:

(a) resistance (b) length (c) area of cross - section **(d) none of the above characteristics**

14) The length of a conductor is halved.Its conductivity will be

(a) halved **(b) unchanged** (c) doubled (d) quadrupled

15) The length of a conductor is halved.Its conductance will be:

(a) halved (b) unchanged **(c) doubled** (d) quadrupled

16) The length and area of cross - section of a conductor are doubled, its resistance will be:

(a) halved **(b) unchanged** (c) doubled (d) quadrupled

17) Ohms law is valid when the temperature of the conductor is:

(a) constant (b) very high (c) very low (d) varying

18) To obtain maximum resistance by joining the given resistors, they should be grouped in

(a) series (b) parallel (c) mixture of series and parallel combinations

19) A wire of resistance 3Ω is cut into there equal pieces, which are joined to from a triangle. The equivalent resistance between any two corners of the triangle is

(a) $\frac{3}{2}\Omega$ **(b)** $\frac{2}{3}\Omega$ (c) $\frac{1}{4}\Omega$ (d) 4Ω

20) For ohmic conductor the drift velocity v_d and the electric field applied across it are related as:

(a) $v_d \propto \sqrt{E}$ **(b)** $\mathbf{v_d \propto E}$ (c) $v_d \propto E^{\frac{3}{2}}$ (d) $v_d \propto E^2$

21) A wire is cut into 4 pieces, which are put together side by side to obtain one conductor. If the original resistance of the wire was R, the resistance of the bundle will be:

(a) R/4 (b) R/8 **(c) R/16** (d) R/32

22) A wire of resistance R is bent in the form of a circle. The resistance between two points on the circumference of the wire and at the end of a diameter of the circle is:

(a) R/4 (b) R/8 (c) R/16 (d) R/32

23) The smallest resistance that can be obtained by the combination of n resistors, each of resistance R is:

(a) R/n^2 **(b) R/n** (c) nR (d) n^2R

24) We have two resistors R_1 and R_2 By using them singly in series and parallel combination we can obtain four resistances of 3,4,12 and 16 ohms. The R_1 and R_2 are:

(a) 3,4 **(b) 4,12** (c) 12,16 (d) 16,3

25) A steady current is set up in a metallic wire of non uniform cross-section. How is the speed of flow v of electrons is related to the area of cross-section A?

(a) v is independent of A **(b)** $\mathbf{v \propto A^{-1}}$ (c) $v \propto A$ (d) $v \propto A^2$

26) The equivalent resistance in series combination is:

(a) smaller than the largest resistance **(b) larger than the largest resistance**
(c) smaller than the smallest resistance (d) larger than the smallest resistance

27) To draw maximum current from a combination of cells, how should the cells be grouped?

(a) series (b) Parallel **(c) Mixed**
(d) Depends upon the relative values of external and internal resistance

28) Five cells each of internal resistance 0.2Ω and e.m.f.2V are connected in series with a resistance of 4Ω.The current through the external resistance is:

(a) 0.2A (b) 0.5A (c) 1A **(d) 2A**

29) You are given three equal resistors. How many groups of resistances can be obtained by joining them in series and parallel grouping?

(a) Two (b) Three **(c) Four** (d) Six

30) An aluminum wire is drawn through die so as to reduce its diameter to half.If the original resistance be R, the new resistance of the wire will be:

(a) R/16 (b) R/4 (c) 4R **(d) 16R**

31) An aluminium wire is drawn through a die so as to double its length.If the original resistance be R, than the new resistance of the wire will be:

(a) R/16 (b) R/4 **(c) 4R** (d) 16R

32) An external resistance R is connected to a cell of internal resistance r.The current in the circuit is maximum when:

(a) $R > r$ **(b) $R < r$** (c) $R = r$ (d) cannot be parallel

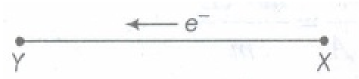
33) Which of the following has -ve temperature coefficient of resistance?

(a) Tungsten **(b) Carbon** (c) Nichrome (d) Platinum

34) The resistivity of material is investment proportional to:

(a) number density of electrons as well and relaxation time
(b) number density of electrons and direction proportional to relaxation time
(c) relaxation time and directly proportional to the number density of electron
(d) neither relaxation time nor number density of electrons.

35) Twenty million electrons reaches from point X to point Y in two micro second as shown in the figure. Direction and magnitude of the current is



(a) 1.5×10^{-10} A from X to Y **(b) 1.6×10^{-6} A from Y to X** (c) 1.5×10^{-13} A from Y to X
(d) 1.6×10^{-4} A from X to Y

36) The relation between electric current density (J) and drift velocity (v_d) is

(a) $J = nev_d$ (b) $J = \frac{ne}{v_d}$ **(c) $J = \frac{v_d e}{n}$** (d) $J = nev^2{}_d$

37) If drift velocity of electron is v_d and intensity of electric field is E, then which of the following relation obeys the Ohm's law?

(a) v_d = constant (b) $v_d \propto E$ (c) $v_d = \sqrt{E}$ **(d) $v_d \propto E^2$**

38) Which of the following characteristics of electrons determines the current in a conductor?

(a) Drift velocity alone (b) Thermal velocity alone (c) Both drift velocity and thermal velocity
(d) Neither drift nor thermal velocity

39) The dimensional formula of resistance is

(a) $[ML^2 T^{-2} A^{-2}]$ (b) $[M^2 L^2 T^3 A^{-2}]$ (c) $[ML^2 T^{-3} A^{-2}]$ (d) $[ML^3 T^{-3} A^{-3}]$

40) The resistance of a 10 m long wire is 10Ω. Its length is increased by 25%by stretching the wire uniformly. The resistance of wire will change to

(a) 12.5 Ω (b) 14.5 Ω **(c) 15.6 Ω** (d) 16.6 Ω

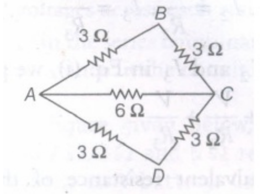
41) A resistor has a colour code of green, blue, brown, and silver. What is its resistance?

(a) 5600 Ω ± 10% (b) 560 Ω ± 5% (c) 560 Ω ± 10% **(d) 56 Ω ± 5%**

42) Multiplication of resistivity and conductivity of any conductor depends on

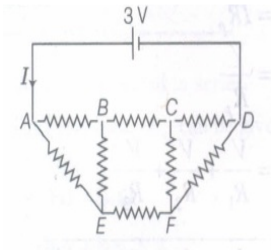
(a) cross-section (b) temperature (c) length **(d) None of these**

43) In the following diagram, equivalent resistance between A and D is



(a) 5 Ω (b) 4 Ω (c) 3Ω **(d) 2Ω**

44) Figure shows a network of eight resistors, each equal to 2Ω, connected to a 3V battery of negligible internal resistance. The current I in the circuit is



(a) 0.25 A (b) 0.50 A (c) 0.75 A **(d) 1.0 A**

45) The equivalent resistance of n resistors each of same resistance when connected in series is R. If the same resistances are connected in parallel, the equivalent resistances will be

(a) R/n^2 (b) R/n (c) n^2 R (d) nR

46) A television of 200 W is used for 4h, then what is the value unit expense of electricity?

(a) 50 (b) 20 **(c) 0.8** (d) 0.2

47) Two bulbs of 40W and 60W are connected to 220V line, the ratio of resistance will be

(a) 4 : 3 (b) 3 : 4 (c) 2 : 3 **(d) 3 : 2**

48) A 100 W-220 V bulb is connected to a supply of 110 V.The power dissipated in the bulb will be

(a) 100 W **(b) 50 W** (c) 25 W (d) 2 W

49) The internal resistance of a 2.1 V cell which gi es a current of 0.2 A through a resistance of 10 Ω is

(a) 0.2 Ω **(b) 0.5 Ω** (c) 0.8 Ω (d) 1.0 Ω

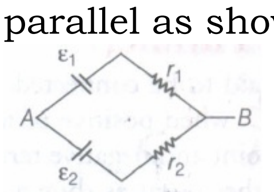
50) The cell has an emf of 2V and the internal resistance of this cell is 0.1Ω, it is connected to resistance of 3.9Ω, the voltage across the cell will be

(a) 1.95 V (b) 1.5V (c) 2 V (d) 1.8 V

51) Electromotive force of primary cell is 2.4 V. When cell is short circuited, then current becomes 4A. Internal resistance of cell is

(a) 60 Ω (b) 1.2 Ω (c) 4 Ω **(d) 0.6 Ω**

52) Two batteries of emf ε_1 and ε_2, ($\varepsilon_2 > \varepsilon_1$) and internal resistances r_1 and r_2 respectively are connected in parallel as shown in figure.



(a) Two equivalent emf ε_{eq} of the two cells is between ε_1 and ε_2 i.e., $\varepsilon_2 < \varepsilon_{eq} < \varepsilon_2$

(b) The equivalent emf ε_{eq} is smaller than ε_1 (c) The ε_{eq} is given by εeq = $\varepsilon_1 + \varepsilon_2$ always

(d) ε_{eq} is independent of internal resistances ε_1 and ε_2

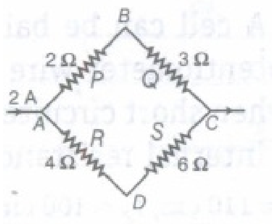
53) Kirchhoff's current law is consequence of conservation of

(a) energy (b) momentum **(c) charge** (d) mass

54) Which of the following draws no current from the voltage source being measured?

(a) Meter bridge (b) Wheatstone bridge **(c) Potentiometer** (d) None of these

55) If 2 A current is flowing in the shown circuit, then potential difference (VB - VD) in balanced condition is

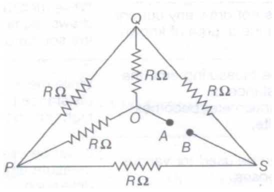


(a) 12 V (b) 6 V (c) 4 V **(d) zero**

56) The Wheatstone bridge and its balance condition provide a practical method for determination of an

(a) known resistance **(b) unknown resistance** (c) Both (a) and (b) (d) None of the above

57) If each of the resistance in the network in figure is R, the equivalent resistance between terminals A and B is



(a) 5 R (b) 2 R (c) 4 R **(d) R**

58) A resistance R is to be measured using a meter bridge, student chooses the standard resistance S to be won. He finds the null point at l, = 2.9 em. He is told to attempt to improve the accuracy. Which of the following is a useful way?

(a) He should measure I_1 more accurately

(b) He should change Sto 1000Ω and repeat the experiment

(c) He should change S to 3Ω and repeat the experiment

(d) He should given up hope of a more accurate measurement with a meter bridge

59) Two cells of emfs approximately 5 V and l0 V are to be accurately compared using a potentiometer of length 400 cm.

(a) The battery that runs the potentiometer should have voltage of 8V

(b) The battery of potentiometer can have a voltage of 15 V and R adjusted so that the potential drop across the wire slightly exceeds 10 V

(c) The first portion of 50 cm of wire itself should have a potential drop of 10 V

(d) Potentiometer is usually used for comparing resistances and not voltages

60) 2 mA current is flowing in the wire of potentiometer of 5m long and 5 Ω resistance. The potential gradient is

(a) 2×10^{-3} V/m (b) 2.5×10^{-2} V/m (c) 1.6×10^{-3} V/m (d) 2.3×10^{-3} V/m

61) A potential difference V is applied to a copper wire of length I and diameter d. If V is doubled, then the drift velocity

(a) is doubled (b) is halved (c) remains same (d) becomes zero

62) A potential difference of 100 V is applied to the ends of a copper wire one metre long. What is the average drift velocity of electrons?
(given.σ = 5.81×10^7 Ω^{-1}or n_{cu} = 8.5×10^{28} m^{-3})

(a) 0.43 ms $^{-I}$ (b) 0.83 ms $^{-I}$ (c) 0.52 ms $^{-I}$ (d) 0.95 ms $^{-I}$

63) Unit of specific resistance is

(a) ohm $^{-1}$ -m $^{-1}$ (b) ohm $^{-1}$ -m (c) ohm-m $^{-1}$ **(d) ohm-m**

64) The length of 50 Ω resistance becomes twice by stretching. The new resistance is

(a) 25 Ω (b) 50 Ω (c) 100 Ω **(d) 200 Ω**

65) A metal rod of length 10 cm and a rectangular cross-section of 1 cm $\times \frac{1}{2}$ cm is connected to a battery across opposite faces. The resistance will be

(a) maximum when the battery is connected across 1 cm $\times \frac{1}{2}$ cm faces

(b) maximum when the battery is connected across 10 cm x 1 cm faces

(c) maximum when the battery is connected across 10 cm$\times \frac{1}{2}$ cm faces

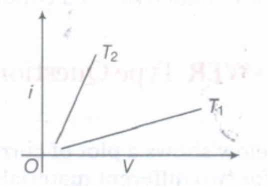
(d) same irrespective of the three faces

66) Corresponding to the resistance 4.7x $10^6\Omega$ ± 5% which is order of colour coding on carbon resistors?

(a) Yellow, violet, blue, gold **(b) Yellow, violet, green, gold** (c) Orange, blue, green, gold

(d) Orange, blue, violet, gold

67) The current i and voltage Vgraph for a given metallic wire at two different temperatures T, and T2 are shown in the figure. It is concluded that

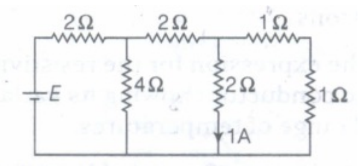


(a) $T_1 > T_2$ (b) $T_1 < T_2$ (c) $T_1 = T_2$ (d) $T_1 = 2T_2$

68) The electromotive force of cell is 5V and its internal resistance is 2 Ω. This cell is connected to external resistance. If the current in the circuit is 0.4 A, then voltage of poles of cell is

(a) 5 V (b) 5.8 V (c) 4.6 V **(d) 4.2 V**

69) The emf of the battery shown in figure is



(a) 12 V **(b) 13 V** (c) 16 V (d) 18 V

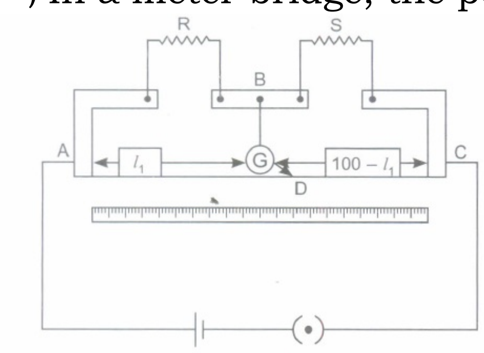
70) Consider a current carrying wire current I in the shape of a circle. Note that as the current progresses along the wire, the direction of j (current density) changes in an exact manner, while the current I remain unaffected. The agent that is essentially responsible for is

(a) source of emf. **(b) electric field produced by charges accumulated on the surface of wire.**

(c) the charges just behind a given segment of wire which push them just the right way by repulsion

(d) the charges ahead.

71) In a meter bridge, the point D is a neutral point (figure).



(a) The meter bridge can have other neutral point for this set of resistances.

(b) When the jockey contacts a point on meter wire left of D, current flows to B from the wire

(c) When the jockey contacts a point on the meter wire to the right of D, current flows from B to the wire through galvanometer.

(d) When R is increased, the neutral point shifts to left.

72) Which of the following is wrong? Resistivity of a conductor is

(a) independent of temperature. (b) inversely proportional to temperature

(c) independent of dimensions of conductor. (d) less than resistivity of a semiconductor.

73) Drift velocity v_d varies with the intensity of electric field as per the relation

(a) $v_d \propto E$ (b) $v_d \propto \frac{1}{E}$ (c) v_d = constant (d) $\boldsymbol{v_d \propto E^2}$

74) For measurement of potential difference, a potentiometer is preferred over voltmeter because

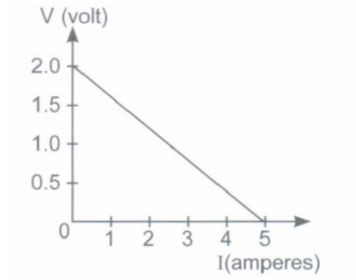
(a) potentiometer is more sensitive than voltmeter.

(b) the resistance of potentiometer is less than voltmeter.

(c) potentiometer is cheaper than voltmeter

(d) potentiometer does not take current from the circuit.

75) For a cell, the graph between the potential difference (V) across the terminals of the cell and the current (I) drawn from the cell is shown in the figure.



(a) $2\ \mathrm{V}, 0.5\Omega$ **(b)** $2\ \mathrm{V}, 0.4\Omega$ (c) $> \mathbf{2V, 0.5\Omega}$ (d) $> \mathbf{2V, 0.4\Omega}$

76) A Daniel cell is balanced on 125 cm length of a potentiometer wire. Now the cell is short-circuited by a resistance 2 ohm and the balance is obtained at 100 cm. The internal resistance of the Daniel cell is

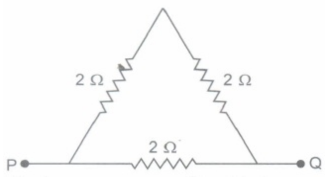
(a) 0.5 ohm (b) 1.5 ohm (c) 1.25 ohm (d) 4/5 ohm

77) When there is an electric current through a conducting wire along its length, then an electric field must exist

(a) outside the wire but normal to it. (b) outside the wire but parallel to it

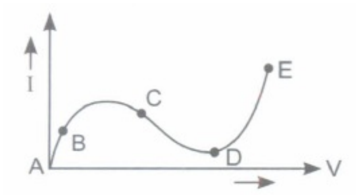
(c) inside the wire but parallel to it. (d) inside the wire but normal to it

78) Three resistors each of 2 ohm are connected together in a triangular shape. The resistance between any two vertices will be



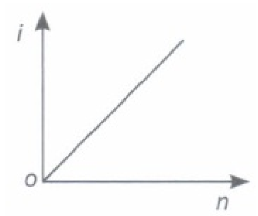
(a) 4/3 ohm (b) 3/4 ohm (c) 3 ohm (d) 6 ohm

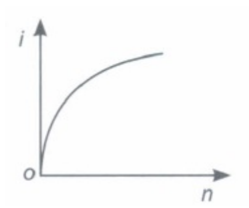
79) From the graph between current I and voltage V shown below, identify the portion corresponding to negative resistance

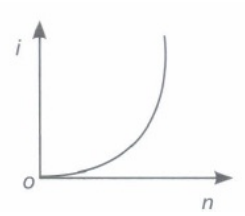


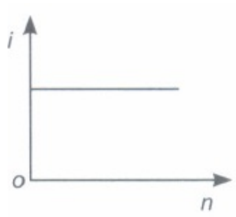
(a) AB (b) BC **(c) CD** (d) DE

80) A battery consists of a variable number 'n' ofidentical cells having internal resistances connected in series. The terminals of battery are short circuited and the current i is measured. Which of the graph below shows the relationship between i and n?

(a) 

(b) 

(c) 

(d) 

81) Kirchhoff's junction rule is a reflection of

(a) conservation of current density vector. (b) conservation of potential

(c) the fact that the momentum with which a charged particle approaches a junction is unchanged (as a vector) as the charged particle leaves the junction

(d) the fact that there is no accumulation of charges at a junction.

82) Temperature dependence of resistivity p(T) of semiconductors, insulators and metals is significantly based on the following factors:

(a) number of charge carriers can change with temperature T

(b) time interval between two successive collisions is independent on T.

(c) length of material can be a function of T. (d) mass of carriers is a function of T

83) Ohm's law is true.

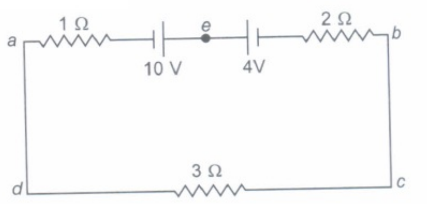
(a) For metallic conductors at low temperature. (b) For metallic conductors at high temperature

(c) For electrolytes when current passes through them (d) For diode when current flows

84) A cell of internal resistance 1.5 Ω and e.m.f. 1.5 volt balances on 500 cm length of a potentiometer wire. If a wire of 15 Ω is connected between the balance point and the cell, then the balance point will shift

(a) to zero (b) by 500 cm (c) by 750 cm **(d) no change**

85) The magnitude and direction of the current in the circuit shown will be



(a) 7/3A from a to b through e (b) 7/3A from b to a through e (c) 1 A from b to a through e

(d) 1 A from a to b through e

86) In an experiment of meter bridge, a null point is obtained at the centre of the bridge wire. When a resistance of 10 ohm is connected in one gap, the value of resistance in other gap is

(a) 10 Ω (b) 5 Ω (c) 15 Ω (d) 500 Ω

87) The terminal potential difference of a cell is greater than its e.m.f. when it is

(a) being discharged. (b) in open circuit **(c) being charged.**

(d) being either charged or discharged.

88) If the length of potentiometer wire is increased, then the length of the previously obtained balance point will

(a) increase. (b) decrease. (c) remain unchanged. (d) become two times.

20 x 1 = 20

89) **Assertion:** Current is a scalar quantity.

Reason: Electric current arises due to continuous flow of charged particles or ions.

Codes:

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is NOT the correct explanation of A

(c) A is true but R is false

(d) A is false and R is also false

Answer : (b): Current is a scalar quantity, it is justified by the following two observations

(i) If current carrying wire is bent at some point, then also current in the wire remains same, while a vector quantity always changes by changing its direction.

(ii) Current flowing in the circuit do not follow the laws of vector addition. It follows according to ordinary rule of algebra. This makes it clear that current is not a vector but a scalar quantity. Also current is defined as rate of flow of charge through the wire 1= dq/ dt.

90) **Assertion :** Insulator do not allow flow of current through them.

Reason: Insulator have no free charge carrier.

Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : (a): Since current arises due to continuous flow of charged particles. There is no free charge in insulator hence no flow of charges are possible. Therefore current do not flow through insulators.

91) **Assertion:** The drift velocity of electrons in a metallic wire will decrease, if the temperature of the wire is increased.
Reason: On increasing temperature, conductance of metallic wire decreases.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : (b): On increasing temperature of wire the kinetic energy of free electrons increase and so they collide more rapidly with each other and hence their drift velocity decreases. Also when temperature increases, resistance increase and resistance is inversely proportional to conductivity of material.

92) **Assertion:** The current flowing through a conductor is directly proportional to the drift velocity.
Reason: As the drift velocity increases the current following through the conductor decreases
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : (c): Consider a conductor of length I and area of cross section A. Time taken by the free electrons to cross the conductor, $t = l/v_d$.
Hence, current, $I = \frac{q}{t} = \frac{Al \times ne}{l/v_d}$
or, $I = \text{Anev}_d$
or, $I \propto v_d$
Thus current is directly proportional to drift velocity.

93) **Assertion:** Chemical reactions involved in primary cells are irreversible and in secondary cells are reversible.
Reason: Primary cells can be recharged, but secondary cells can not be recharged.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : (c): Primary cells cannot be recharged because they involve irreversible reactions. Secondary cells can be recharged because they involve reversible reactions.

94) **Assertion:** The average thermal velocity of the electrons in a conductor is zero.
Reason: Direction of motion of electrons are randomly oriented.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : (a): In normal conductor, the direction of electrons are randomly oriented such that the total sum of their velocities is equal to zero.

95) **Assertion:** If the length of the conductor is doubled, the drift velocity will become half of the original value (keeping potential difference unchanged).

Reason : At constant potential difference, drift velocity is inversely proportional to the length of the conductor.

Codes:

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : (a): Drift velocity of free electrons is given by $v_d = \frac{eE}{m}\tau$
where, $E = \frac{\text{Potential difference}}{\text{length}} = \frac{V}{l}$
$\therefore \quad v_d = \frac{eV}{ml}\tau$ i.e., $v_d \propto 1/l$ where, $\frac{eV\tau}{m}$
It mean if I is doubled, the drift velocity will become half of the original value.

96) **Assertion:** The temperature coefficient of resistance is always positive only for metals.

Reason: On increasing the temperature, the resistance of metals and alloys increases.

Codes:

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : **(b):** The value of temperature coefficient of resistance is positive only for metals and alloys and is negative for semiconductors and insulators.

97) **Assertion:** Material used in the construction of a standard resistance is constant an or manganin.

Reason: Temperature coefficient of constantan is very small.

Codes:

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : **(a):** These alloys (constantan or manganin) are used for making standard resistance because they possess high resistivity and low temperature coefficient of resistance

98) **Assertion:** kWhr is a commercial unit used for expressing consumed electric energy.

Reason: Kilo-watt hour is the unit of electric power.

Codes:

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : **(c):** 1 kWhr = 1 kW x 1 hour
= 1000 (joule/see) x 3600 see = 36 x 10^5 joule
i.e., kWhr is the unit of electric energy and used for expressing consumed electric energy.

99) **Assertion:** The 200 W bulbs glows with more brightness than 100 W bulbs.

Reason: A 100 watt bulb has more resistance than a 200 W bulb.

Codes:

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : **(b):** The resistance $R = \frac{V^2}{P}$, i.e., $R \propto 1/P$
i.e., higher is the wattage of a bulb, lesser is the resistance and so it will glow bright

100) **Assertion:** Heater wire must have high resistance and high melting point.
Reason: If resistance is high, the electric conductivity will be less.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : (b): Heater wire must have high resistance and high melting point, because in series current remains same, therefore according to Joule's lawH = i^2Rt / 4.2, heat produced is high if R is high. Melting point must be high, so that wire may not melt with increase in temperature.

101) **Assertion**: Fuse wire must have high resistance and low melting point.
Reason: Fuse is used for small current flow only.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : (c): Fuse wire must have high resistance because in series, current remains same. Therefore according to Joule's law $H = \frac{i^2Rt}{4.2}$ heat produced is high if R is high. The melting point must be low so that wire may melt with increase in temperature. As a current larger than the specified value flows through the circuit the temperature of the fuse wire increases. This melts the fuse wire and breaks the circuit.

102) **Assertion:** In a chain of bulbs, 50 bulbs are joined in series. One bulb is removed now the circuit is again completed. If the remaining 49 bulbs are again connected in series across the same supply, then light gets decreased in the room.
Reason: The resistance of 49 bulbs will be more than 50 bulbs.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : (d): Since the bulbs are joined in series, so when one bulb is removed from chain then the resistance of the chain is decreased, hence current flowing through each bulb is increased. As heat produced $\propto i^2$ hence light gets increased in the room.

103) **Assertion:** Two electric bulbs of 50 and 100 watt are given. When connected in series 50 watt bulb glows more but when connected in parallel 100 watt bulb glows more .
Reason: In series combination, power is directly proportional to the resistance of circuit. But in parallel combination, power is inversely proportional to the resistance of the circuit.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : (a): Resistance of 50 watt bulb is two times the resistance of 100 watt bulb. When bulbs are connected in series, 50 watt bulb will glow more as P = i^2R (current remains same in series). In parallel, the 100 watt bulb will glow more as P = V^2/R (potential difference remain same in parallel).

104) **Assertion:** Two bulbs of same wattage, one having a carbon filament and the other having a metallic filament are connected in series. Metallic bulbs will glow more brightly than carbon filament bulb.
Reason: Carbon is a semiconductor.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A

(c) A is true but R is false
(d) A is false and R is also false

Answer : (d): When two bulbs are connected in series, the resistance of the circuit increases and so the voltage in each decreases, hence the brightness and the temperature also decreases. Due to decrease in temperature, the resistance of the carbon filament will slightly increase while that of metal filament will decrease. Hence, carbon filament bulb will glow more brightly ($P = i^2R$). Also carbon is not a semiconductor

105) **Assertion:** It is advantageous to transmit electric power at high voltage.
Reason: High voltage implies high current.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : (c): As P = Vi, hence for the transmission of same power, high voltage implies less current. Therefore heat energy loses ($H = i^2 Rt / 4.2$) are minimized if power is transmitted at high voltage.

106) **Assertion**: A person touching a high power line gets stuck with the line.
Reason: The current carrying wire attracts the man towards it.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : (d): Because there is no special attractive force that keeps a person stuck with a high power line. The actual reason is that a current of the order of 0.05 A or even less is enough to bring disorder in our nervous system. As a result of it, the affected person may lose temporarily his ability to control his nervous system to get himself free from the high power line.

107) **Assertion:** Though the same current flows through the live wires and the filament of the bulb but heat produced in the filament is much higher than that in live wires.
Reason: The filament of bulbs is made of a material of high resistance and high melting point.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : (b): As filament of bulb and live wire are in series, hence current through both is same. Now, because $H = \frac{i^2Rt}{4.2}$ and resistance of the filament of the bulb is much higher than that of live wires, hence heat produced in the filament is much higher than that in line wires.

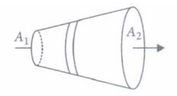
108) **Assertion:** The current in a wire is due to flow of free electrons in a definite direction.
Reason: A current carrying wire should have non -zero charge.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Answer : (c): The current in a wire is due to flow of free electrons in a definite direction. But the number of protons in the wire at any instant is equal to number of electrons and charge on electrons is equal and opposite to that of proton. Hence, net charge on the wire is zero.

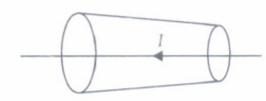
16 x 4 = 64

109) The flow of charge in a particular direction constitutes the electric current. Current is measured in Ampere. Quantitatively, electric current in a conductor across an area held perpendicular to the direction of flow of charge is defined as the amount of charge is flowing across that area per unit time.

Current density at a point in a conductor is the ratio of the current at that point in the conductor to the area of cross section of the conductor of that point.
The given figure shows a steady current flows in a metallic conductor of non uniform cross section. Current density depends inversely on area, so, here $J_1 > J_2$, as $A_1 < A_2$.



(i) What is the current flowing through a conductor, if one million electrons are crossing in' one millisecond through a cross-section of it ?
(a) 2.5 x 10^{-10} A (b) 1.6 x 10^{-10} A
(c) 7.5 X 10^{-9} A (d) 8.2 x 10^{-11} A
(ii) SI unit of electric current is
(a) Cs (b) Ns^{-2} (c) Cs^{-1} $C^{-1}s^{-1}$
(iii) A steady current flows in a metallic conductor of non-uniform cross-section. Which of these quantities is constant along the conductor?
(a) Electric field (b) Drift velocity (c) Current (d) Current density
(iv) A constant current I is flowing along the length of a conductor of variable cross-section as shown in the figure. The quantity which does not depend upon the area of cross-section is



(a) electron density (b) current density
(c) drift velocity (d) electric field
(v) When a current of 40 A flows through a conductor of area 10 m^2, then the current density is
(a) 4 A/m^2 (b) 1 A/m^2 (c) 2 A/m^2 (d) 8 A/m^2

Answer : (I) (b): $q = 10^6 \times 1.6 \times 10^{-19} \mathrm{C} = 1.6 \times 10^{-13} \mathrm{C}$
t = 10^{-3} s
$I = \frac{q}{t} = \frac{1.6 \times 10^{-13}}{10^{-3}} = 1.6 \times 10^{-10}$ A
(ii) (C): C S^{-1}
(iii) (C): The current flowing through a conductor of non-uniform cross-section remain same in the whole of the conductor.
(iv) (a): When a constant current is flowing through a conductor of non-uniform cross-section, electron density does not depend upon the area of cross section, while current density, drift velocity and electric field all vary inversely with area of cross-section.
(v) (a): Given,1=40 A ;A = 10m^2
$\therefore$ Current density, $J = \frac{I}{A}$ or $J = \frac{40}{10} = 4 \mathrm{~A/m^2}$

110) According to Ohm's law, the current flowing through a conductor is directly proportional to the potential difference across the ends of the conductor i.e $I \propto V \Rightarrow \frac{V}{I} = R$ where R is resistance of the conductor Electrical resistance of a conductor is the obstruction posed by the conductor to the flow of electric current through it. It depends upon length, area of cross-section, nature of material and temperature of the conductor We can write $R \propto \frac{l}{A}$ or $R = \rho \frac{l}{A}$ where ρ is electrical resistivity of the material of the conductor.
(i) Dimensions of electric resistance is
(a) $[\mathrm{ML^2 T^{-2} A^{-2}}]$ (b) $[ML^2T^{-3}A^{-2}]$ (c) $[\mathrm{M^{-1} L^{-2} T^{-1} A}]$ (d) $[M^{-1}L^2T^2A^{-1}]$
(ii) If $1\mu\mathrm{A}$ current flows through a conductor when potential difference of2 volt is applied across its ends, then the resistance of the conductor is
(a) $2 \times 10^6 \Omega$ (b) $3 \times 10^5 \Omega$ (c) $1.5 \times 10^5 \Omega$ (d) $5 \times 10^7 \Omega$
(iii) Specific resistance of a wire depends upon
(a) length (b) cross-sectional area (c) mass (d) none of these
(iv) The slope of the graph between potential difference and current through a conductor is
(a) a straight line (b) curve

(c) first curve then straight line **(d) first straight line then curve**

(v) The resistivity of the material of a wire 1.0 m long, 0.4 mm in diameter and having a resistance of 2.0 ohm is

(a) $1.57 \times 10^{-6} \Omega \mathrm{m}$ (b) $5.25 \times 10^{-7} \Omega \mathrm{m}$ (c) $7.12 \times 10^{-5} \Omega \mathrm{m}$ (d) $2.55 \times 10^{-7} \Omega \mathrm{m}$

Answer : **(i) (b)**

(ii) (a): $R = \frac{V}{I} = \frac{2}{10^{-6}} = 2 \times 10^{6} \Omega$

(iii) (d): Specific resistance depends upon the nature of material and is independent of mass and dimensions of the material

(iv) (a)

(v) (d): l = 1.0 m; D = 0.4 mm = 4×10^{-4}m

$R = 2\Omega$

$A = \frac{\pi D^2}{4} = \frac{\pi \times (4 \times 10^{-4})^2}{4} = 4\pi \times 10^{-8} \mathrm{~m}^2$

Now, $\rho = \frac{RA}{l} = \frac{2 \times 4\pi \times 10^{-8}}{1} = 2.55 \times 10^{-7} \Omega \mathrm{m}$

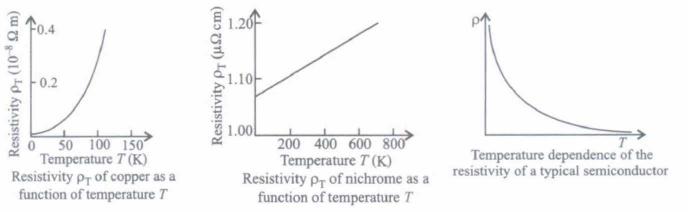
111) The resistance of a conductor at temperature t°C is given by $R_t = R_o (1 + \alpha t)$
where R_t is the resistance at t°C, R_o is the resistance at 0°C and α is the characteristics constants of the material of the conductor.

Over a limited range of temperatures, that is not too large. The resistivity of a metallic conductor is approximately given by $\rho_t = \rho_0(1 + \alpha t)$.

where α is the temperature coefficient of resistivity. Its unit is K^{-1} or $^{\circ}\mathrm{C}^{-1}$

For metals, α is positive i.e., resistance increases with rise in temperature.

For insulators and semiconductors, α is negative i.e., resistance decreases with rise in temperature.



(i) Fractional increase in resistivity per unit increase in temperature is defined as

(a) resistivity **(b) temperature coefficient of resistivity**

(c) conductivity **(d) drift velocity**

(ii) The material whose resistivity is insensitive to temperature is

(a) silicon (b) copper (c) silver (d) nichrome

(iii) The temperature coefficient of the resistance of a wire is 0.00125 per °C. At 300 K its resistance is 1 ohm. The resistance of wire will be 2 ohms at

(a) 1154 K (b) 1100 K (c) 1400 K (d) 1127 K

(iv) The temperature coefficient of resistance of an alloy used for making resistors is

(a) small and positive **(b) small and negative** **(c) large and positive** **(d) large and negative**

(v) For a metallic wire, the ratio V/I (V = applied potential difference and I = current flowing) is

(a) independent of temperature

(b) increases as the temperature rises

(c) decreases as the temperature rises

(d) increases or decreases as temperature rises depending upon the metal

Answer : (i) (b): Temperature coefficient of resistivity is defined as the fractional increase in resistivity per unit increase in temperature.

(ii) (d): Nichrome (which is an alloy of nickel, iron and chromium) exhibits a very weak dependence of resistivity with temperature.

(iii) (d): Using, $R_T = R_0(1+\alpha T)$

$$\therefore \quad \frac{R_{T_2}}{R_{T_1}} = \frac{R_0(1+\alpha T_2)}{R_0(1+\alpha T_1)} = \frac{2}{1} = \frac{(1+\alpha T_2)}{(1+\alpha \times 300)}$$

$$\Rightarrow \quad 2+\alpha \times 600 = 1+\alpha T_2$$

$$\Rightarrow \quad 1 = \alpha\,(T_2 - 600) \Rightarrow \frac{1}{0.00125} = (T_2 - 600)$$

$$\Rightarrow \quad 800^\circ\mathrm{C} = T_2 - 600$$

T_2 = 800 - 273 + 600

T_2 = 1127 K

(iv) (a): The temperature coefficient of resistance of an alloy used for making resistors is small and positive.

(v) (b): The resistance of a metallic wire at temperature t^{o}C is given by

$R_t = R_0(1+\alpha t)$ where α is the temperature coefficient of resistance and R_o is the resistance of a wire at O°c.

For metals,α is positive. Hence, resistance of a wire increases with increase in temperature.

Also, from Ohm's law

$\frac{V}{I} = R$

Hence on increasing the temperature, the ratio $\frac{V}{I}$ increases.

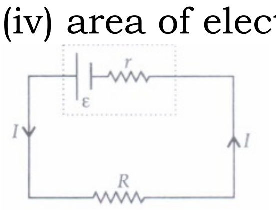
112) Emf of a cell is the maximum potential difference between two electrodes of the cell when no current is drawn from the cell. Internal resistance is the resistance offered by the electrolyte of a cell when the electric current flows through it. The internal resistance of a cell depends upon the following factors;

(i) distance between the electrodes

(ii) nature and temperature of the electrolyte

(iii) nature of electrodes

(iv) area of electrodes.



For a freshly prepared cell, the value of internal resistance is generally low and goes on increasing as the cell is put to more and more use. The potential difference between the two electrodes of a cell in a closed circuit is called terminal potential difference and its value is always less than the emf of the cell in a closed circuit. It can be written as V = E - Jr.

(i) The terminal potential difference of two electrodes of a cell is equal to emf of the cell when

(a) $I \neq 0$ **(b) I=0** **(c) both (a) and (b)** **(d) neither (a)nor (b)**

(ii) A cell of emf E and internal resistance r gives a current of 0.5 A with an external resistance of 12Ω and a current of 0.25 A with an external resistance of 25Ω .What is the value of internal resistance of the cell?

(a) 5Ω (b) 1Ω (c) 7Ω (d) 3Ω

(iii) Choose the wrong statement.

(a) Potential difference across the terminals of a cell in a closed circuit is always less than its emf.

(b) Internal resistance of a cell decrease with the decrease in temperature of the electrolyte.

(c) Potential difference versus current graph for a cell is a straight line with a -ve slope

(d) Terminal potential difference of the cell when it is being charged is given as V = E + Ir.

(iv) An external resistance R is connected to a cell of internal resistance r, the maximum current flows in the external resistance, when

(a) R = r (b) R < r (c) R > r (d) R=1/r

(v) IF external resistance connected to a cell has been increased to 5 times, the potential difference across the terminals of the cell increases from 10 V to 30 V. Then, the emf of the cell is

(a) 30 V (b) 60V (c) 50 V (d) 40 V

Answer : (i) (b)

(ii) (b): As $I=\frac{\varepsilon}{R+r}$

In first case, $I=0.5\text{ A}; R=12\Omega$

$0.5=\frac{\varepsilon}{12+r}\Rightarrow\varepsilon=6.0+0.5r$ ....(i)

In second case $I=0.25\text{ A}; R=25\Omega$

$\varepsilon=6.25+0.25r$ ...(ii)

From equation (i) and (ii), r = 1Ω

(iii) (b)

(iv) (a): Current in the circuit $I=\frac{E}{R+r}$

Power delivered to the resistance R is

$$P=I^2R=\frac{E^2R}{(R+r)^2}$$

It is maximum when $\frac{dP}{dR}=0$

$$\frac{dP}{dR}=E^2\left[\frac{(r+R)^2-2R(r+R)}{(r+R)^4}\right]=0$$

or $(r+R)^2=2R(r+R)$ or $R=r$

(v) (b): For first case, $\frac{\varepsilon}{R+r}=\frac{10}{R}$ ...(i)

For second case, $\frac{\varepsilon}{5R+r}=\frac{30}{5R}$

Dividing (i) by (ii), we get r = 5R

From (i), $\frac{E}{R+5R}=\frac{10}{R}$

E=60 V

113) Metals have a large number of free electrons nearly 10^{28} per cubic metre. In the absence of electric field, average terminal speed of the electrons in random motion atroom temperature is of the order of 10^5 m s^{-1}When a potential difference V is applied across the two ends of a given conductor, the free electrons in the conductor experiences a force and are accelerated towards the positive end of the conductor. On their way, they suffer frequent collisions with the ions/atoms of the conductor and lose their gained kinetic energy. After each collision, the free electrons are again accelerated due to electric field, towards the positive end of the conductor and lose their gained kinetic energy in the next collision with the ions/atoms of the conductor. The average speed of the free electrons with which they drift towards the positive end of the conductor under the effect of applied electric field is called drift speed of the electrons.

(i) Magnitude of drift velocity per unit electric field is

(a) current density **(b) current** **(c) resistivity** **(d) mobility**

(ii) The drift speed of the electrons depends on

(a) dimensions of the conductor

(b) number density of free electrons in the conductor

(c) both (a) and (b)

(d) neither (a) nor (b)

(iii) We are able to obtain fairly large currents in a conductor because

(a) the electron drift speed is usually very large

(b) the number density of free electrons is very high and this can compensate for the low values of t electron drift speed and he very small magnitude of the electron charge

(c) the number density of free electrons as well as the electron drift speeds are very large and these compensate for the very small magnitude of the electron charge

(d) the very small magnitude of the electron charge has to be divided by the still smaller product of number density and drift speed to get the electric current

(iv) Drift speed of electrons in a conductor is very small i.e., i = 10^{-4} m s^{-1}. The Electric bulb glows immediately. When the switch is closed because

(a) drift velocity of electron increases when switch is closed

(b) electrons are accelerated towards the negative end of the conductor

(c) the drifting of electrons takes place at the entire length of the conductor

(d) the electrons of conductor move towards the positive end and protons of conductor move towards negative end of the conductor

(v) The number density offree electrons in a copper conductor is 8.5 x 10^{28} m^{-3}. How long does an electron take to drift from one end of a wire 3.0 m long to its other end? The area of cross-section of the wire is 2.0 x 10^{-6}m2 and it is carrying a current of 3.0 A.

(a) 8.1 x 10^4 s (b) 2.7 x 10^4 s (c) 9 x 10^3 s (d) 3 x 10^3 S

Answer : (i) (d): Mobility is defined as the magnitude of drift velocity per unit electric field

Mobility, $\mu = \frac{|v_d|}{E}$

(ii) (c): Drift velocity $v_d = \frac{I}{neA}$

where the symbols have their usual meanings

(iii) (b): I = $neAv_d$

v_d is of order offew m S^{-I}, e = 1.6 x 10^{-19} C,

A is of the order of mm^2, so a large I is due to a large value of n in conductors.

(iv) (c): When we close the circuit, an electric field is established instantly with the speed of electromagnetic wave which causes electrons to drift at every portion of the circuit, due to which the current is set up in the entire circuit instantly. The current which is set up does not wait for electrons to flow from one end of the conductor to another. Thus, the electric bulb glows immediately when switch is closed.

(v) (b): Here,

Number density of free electrons, n = 8.5 x 10^{28} m^{-3}

Area of cross-section of a wire, A = 2.0 x 10^{-6} m^2

Length of the wire, 1= 3.0 m

Current, 1= 3.0 A

The drift velocity of an electron is $v_d = \frac{I}{neA}$ ...(i)

The time taken by the electron to drift from one end to other end of the wire is

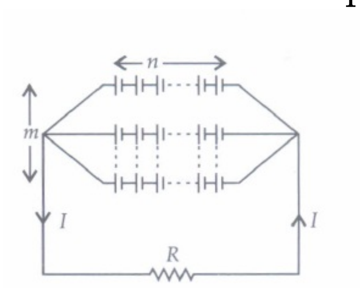
$t = \frac{l}{v_d} = \frac{\ln eA}{I}$

$= \frac{(3.0 \text{ m})(8.5\times10^{28} \text{ m}^{-3})(1.6\times10^{-19}\text{C})(2.0\times10^{-6} \text{ m}^2)}{(3.0 \text{ A})}$

= 2.7 x 10^4 s

114) A single cell provides a feeble current. In order to get a higher current in a circuit, we often use a combination of cells A combination of cells is called a battery, Cells can be joined in series, parallel or in a mixed way.

Two cells are said to be connected in series when negative terminal of one cell is connected to positive terminal of the other cell and so on. Two cells are said to be connected in parallel if positive terminal of each cell is connected to one point and negative terminal of each cell connected to the other point. In mixed grouping of cells, a certains number of identical cells are joined in series, and all such rows are then connected in parallel with each other.



(i) To draw the maximum current from a combination of cells, how should the cells be grouped?

(a) Parallel (b) Series (c) Mixed grouping (d) Depends upon the relative values of internal and external resistances

(ii) The total emf of the cells when n identical cells each of emf e are connected in parallel is

(a) $n\varepsilon$ (b) $n^2\varepsilon$ **(c) E** d) $\frac{\varepsilon}{n}$

(iii) 4 cells each of emf 2 V and internal resistance of 1Ω are connected in parallel to a load resistor of 2Ω. Then the current through the load resistor is

(a) 2 A (b) 1.5 A (c) 1 A (d) 0.888 A

(iv) If two cells out of n number of cells each of internal resistance 'r' are wrongly connected in series, then total resistance of the cell is

(a) 2nr (b) nr - 4r (c) nr (d) r

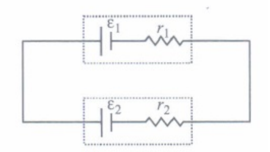
(v) Two identical non-ideal batteries are connected in parallel. Consider the following statements.

(i). The equivalent emf is smaller than either of the two emfs.

(ii) The equivalent internal resistance is smaller than either of the two internal resistances

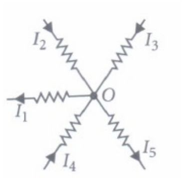
(a) Both (i) and (ii) are correct. **(b) (i) is correct but (ii) is wrong**
(c) (ii) is correct but (i) is wrong. **(d) Both (i) and (ii) are wrong.**

Answer : (i) (d)
(ii) (c): For parallel combination of n celis, $\varepsilon_{eq} = \varepsilon$
(iii) (d): $I = \frac{mE}{mR+r}$ m= number of cells = 4
$E = 2\text{ V}, R = 2\Omega, r = 1\Omega$
$I = \frac{8}{8+1} = \frac{8}{9} = 0.888\text{ A}$
(iv) (b)
(v) (c): Let two cells of emf's E_1 and E_2 and of internal resistance r_1 and r_2 respectively are connected in parallel



The equivalent emf is given by
$\varepsilon_{\text{eq}} = \frac{\varepsilon_1 r_2 + \varepsilon_2 r_1}{r_1 + r_2}$...(I)
The equivalent internal resistance is given by
$\frac{1}{r_{\text{eq}}} = \frac{1}{r_1} + \frac{1}{r_2}$ or $r_{\text{eq}} = \frac{r_1 r_2}{r_1 + r_2}$
Let us consider, two cells connected in parallel of same emf E and same internal resistance r.
From equatio. n (i), we get $\varepsilon_{\text{eq}} = \frac{\varepsilon r + \varepsilon r}{r + r} = \varepsilon$
From equation (ii), we get
$r_{\text{eq}} = \frac{r^2}{r+r} = \frac{r}{2}$

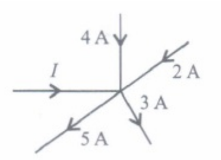
115) In 1942, a German physicist Kirchhoff extended Ohm's law to complicated circuits and gave two laws, which enable us to determine current in any part of such a circuit. According to Kirchhoff's first rule, the algebraic sum of the currents meeting at a junction in a closed electric circuit is zero. The current flowing in a conductor towards the junction is taken as positive and the current flowing away from the junction is taken as negative. According to Kirchhoff's second rule, in a closed loop, the algebraic sum of the emf's and algebraic sum of the products of current and resistance in the various arms of the loop is zero. While traversing a loop, if negative pole of the cell is encountered first, then its emf is negative, otherwise positive.



(i) Kirchhoff's I^{st} law follows

(a) law of conservation of energy **(b) law of conservation of charge**
(c) law of conservation of momentum **(d) Newton's third law of motion**

(ii) The value of current I in the given circuit is



(a) 4.5 A **(b) 3.7 A** **(c) 2.0 A** **(d) 2.5 A**

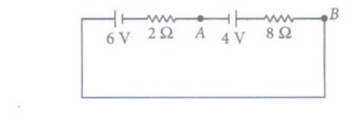
(iii) Kirchhoff's II^{nd} law is based on
(a) law of conservation of momentum of electron **(b) law of conservation of charge and energy**
(c) law of conservation of energy **(d) none of these.**

(iv) Point out the right statements about the validity of Kirchhoff's Junction rule.
(a) The current flowing towards the junction are taken as positive.
(b) The currents flowing away from the junction are taken as negative.

(c) bending or reorienting the wire does not change the validity of Kirchhoff's Junction rule

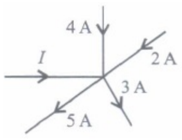
(d) All ofthe above

(v) Potential difference between A and B in the circuit shown here is



(a) 4 V **(b) 5.6 V** **(c) 2.8 V** **(d) 6 V**

Answer : (i) (a): Kirchhoff's Ist law is based on law of conservation of charge whereas Kirchhoff's IInd law is based on law of conservation of energy.

(ii) (c): 

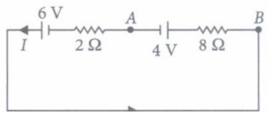
According to Kirchhoff's junction law

(+ I) + (+ 4 A) + (+ 2 A) + (- 5 A) + (- 3 A) = 0

I + 6 A - 8 A = 0 or I = 2 A

(iii) (c)

(iv) (d)

(v) (b): 

Apply KVL in the given circuit,

6 - 8I - 4 - 2I= 0

or, 2 - 10I= 0 or, I= 2/10 = 0.2 A

V_{AB} = 4 + I x 8 = 4 + 0.2 x 8 = 5.6 V

116) Wheatstone bridge is an arrangement of four resistances P, Q, Rand S connected as shown in the figure. Their values are so adjusted that the galvanometer G shows no deflection. The bridge is then said to be balanced when this condition is achieved happens. In the setup shown here, the points Band D are at the same potential and it can be shown that $\frac{P}{Q} = \frac{R}{S}$

This is called the balancing condition. If any three resistances are known, the fourth can be found. The practical form of Wheatstone bridge is slide wire bridge or Meter bridge. Using this the unknown resistance can be determined as $S = \left(\frac{100-l}{l}\right) \times R$,where I is the balancing length of the Meter bridge.

(i) In a Wheatstone bridge circuit, $P = 5\Omega, Q = 6\Omega, R = 10\Omega$ and $S = 5\Omega$ What is the value of additional resistance to be used in series with S, so that the bridge is balanced?

(a) 9Ω (b) 7Ω (c) 10Ω (d) 5Ω

(ii) A Wheatstone bridge consisting of four arms of resistances P, Q, R, S is most sensitive when

(a) all the resistances are equal

(b) all the resistances are unequal

(c) the resistances P and Q are equal but R > > P and S > > Q

(d) the resistances P and Q are equal but R < < P and S < < Q

(iii) When a metal conductor connected to left gap of a meter bridge is heated, the balancing point

(a) shifts towards right **(b) shifts towards left** **(c) remains unchanged** **(d) remains at zero**

(iv) The percentage error in measuring resistance with a meter bridge can be minimized by adjusting the balancing point close to

(a) 0 **(b)·20cm** **(c) 50cm** **(d) 80cm**

(v) In a meter bridge experiment, the ratio ofleft gap resistance to right gap resistance is 2 : 3. The balance point from left is

(a) 20 cm **(b) 50 cm** **(c) 40 cm** **(d) 60 cm**

Answer : (I) (b): $(S+x)=\frac{Q}{P}R$

$x=\frac{Q}{P}R-S=\frac{6}{5}\times 10-5=7\Omega$

(ii) (a): A Wheatstone bridge consisting of four arms of resistance P, Q, R, S is most sensitive when all the resistances are equal.

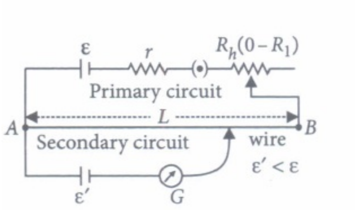
(iii) (a) : When metal wire is heated, its resistance increases R_1 increases,L_1 increases.
The null point shift to the right.

(iv) (c): The percentage error in measuring resistance with a metre bridge can be minimized by adjusting the balancing point near the middle of the bridge i.e. close to 50 cm

(v) (c): $\frac{P}{Q}=\frac{l_1}{100-l_1}$ or $\frac{2}{3}=\frac{l_1}{100-l_1}$

or $5l_1=200$ or $l_1=40$ cm

117) Potentiometer is an apparatus used for measuring the emf of a cell or potential difference between two points in an electrical circuit accurately. It is also used to determine the internal resistance of a primary cell. The potentiometer is based on the principle that, if V is the potential difference across any portion of the wire of length 1 and resistance R, then $V\propto l$ or $V=kl$ where k is the potential gradient. Thus, potential difference across any portion of potentiometer wire is directly proportional to length of the wire of that portion. The potentiometer wire must be uniform. The resistance of potentiometer wire should be high.



(i) Which one of the following is true about potentiometer?

(a) Its sensitivity is low

(b) It measures the emf of a cell very accurately

(c) It is based on deflection method

(d) None of the above

(ii) A current of 1.0 mA is flowing through a potentiometer wire of length 4 cm and of resistance 4Ω .The potential gradient of the potentiometer wire is

(a) $10^{-3}Vm^{-1}$ (b) $10^{-5}Vm^{-2}$ (c) $2\times 10^{-3}Vm^{-1}$ (d) $4\times 10^{-3}Vm^{-1}$

(iii) Sensitivity of a potentiometer can be increased by

(a) decreasing potential gradient along the wire **(b) increasing potential gradient along the wire**

(c) decreasing current through the wire **(d) increasing current through the wire**

(iv) A potentiometer is an accurate and versatile device to make electrical measurements of EMF because the method involves

(a) potential gradients

(b) a condition of no current flow through the galvanometer

(c) a combination of cells, galvanometer and resistances

(d) cells

(v) In a potentiometer experiment, the balancing length is 8 m, when the two cells E_1 and E_2 are joined in series. When the two cells are connected in opposition the balancing length is 4 m. The ratio of the e. m. f. of two cells (E_1/E_2) is

(a) 1: 2 **(b) 2: 1** **(c) 1: 3** **(d) 3: 1**

Answer : (i) (b)

(ii) (a): Given, $I = 1.0 \text{ mA} = 10^{-3} \text{ A}; R = 4\Omega; L = 4 \text{ m}$

Potential drop across potentiometer wire

V = IR = 10^{-3} X 4 V

Potential gradient, $k = \frac{V}{L} = \frac{4 \times 10^{-3}}{4}$

= 10^{-3} V m^{-1}

(iii) (a)

(iv) (b): A potentiometer is an accurate and versatile device to make electrical measurements of EMF because the method involves a condition of no current flow through the galvanometer. It can be used to

measure potential difference, internal resistance of a cell and compare EMF's of two sources.

(v) (d): $\frac{E_1}{E_2} = \frac{l_1+l_2}{l_1-l_2} = \frac{8+4}{8-4} = \frac{12}{4} = \frac{3}{1}$

118) Whenever an electric current is passed through a conductor, it becomes hot after some time. The phenomenon of the production of heat in a resistor by the flow of an electric current through it is called heating effect of current or Joule heating. Thus, the electrical energy supplied by the source of emf is converted into heat. In purely resistive circuit, the energy expended by the source entirely appears as heat. But if the circuit has an active element like a motor, then a part of the energy supplied by the source goes to do useful work and the rest appears as heat. Joule's law of heating form the basis of various electrical appliances such as electric bulb, electric furnace,
electric press etc.

(i) Which of the following is a correct statement?

(a) Heat produced in a conductor is independent of the current flowing

(b) Heat produced in a conductor varies inversely as the current flowing

(c) Heat produced in a conductor varies directly as the square of the current flowing

(d) Heat produced in a conductor varies inversely as the square of the current flowing

(ii) If the coil of a heater is cut to half, what would happen to heat produced?

(a) Doubled **(b) Halved** **(c) Remains same** **(d) Becomes four times**

(iii) A 25 Wand 100 Ware joined in series and connected to the mains. Which bulbs will glow brighter?

(a) 100W **(b) 25 W**

(c) both bulbs will glow brighter **(d) none will glow brighter**

(iv) A rigid container with thermally insulated wall contains a coil of resistance 100Ω carrying current 1A. Change in its internal' energy after 5 min will be

(a) 0 kJ **(b) 10 kJ** **(c) 20 kJ** **(d) 30 kJ**

(v) The heat emitted by a bulb of 1.90W in 1 min is

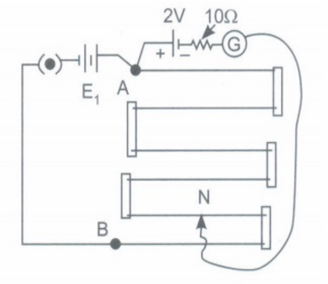
(a) 100 J **(b) 1000 J** **(c) 600 J** **(d) 6000 J**

Answer : **(i) (c):** According to Joule's law of heating, Heat produced in a conductor, H= I^2Rt
where, I = Current flowing through the conductor
R = Resistance of the conductor
t = Time for which current flows through the conductor.
$\therefore \quad H \propto I^2$
(ii) (a): If the coil is cut into half, its resistance is also halved.
As $H = \frac{V^2}{R}t \quad \therefore \quad H' = 2$
(iii) (b): $P = \frac{V^2}{R}$ or $R = \frac{V^2}{P}$
The bulbs are joined in series. Current in both the bulbs will same
$\therefore$ The heat produced in them is given by H = I^2Rt
or $H \propto R \Rightarrow H \propto \frac{1}{P}$
Therefore the bulb with low wattage or high resistance will glow brighter or we can say the 25 W bulb will glow brighter than the 100 W bulb.
(iv) (d): $R = 100\Omega; I = 1\text{ A}; t = 5\text{ min.} = 5 \times 60 = 300\text{ s}$
change in internal energy = heat generated in coil
$= I^2Rt = \left((1)^2 \times 100 \times 300\right)\text{ J}$
= 30000 J = 30 kJ
(v) (d): Here, P = 100 W, t = 1 min = 60 s
Heat developed in time t
H = P x t = (100 W)(60 s) = 6000 J

119) When a conductor does not have a current through it, its conduction electrons move randomly, with no net motion in any direction. When the conductor does have a current through it, these electrons actually still move randomly, but now they tend to drift with a drift speed Vα in the direction opposite to the applied electric field that causes current. The drift speed is very small as compared to the speeds in the random motion. For example, in the copper r conductors of household wiring, electron drift speeds are perhaps 10^{-5} ms^{1} to 10^{-3} ms^{-1} where as the random speed is around 10^{6} ms^{-1} .
(i) The electron drift speed is estimated to be only a few mm S^{-1} for currents in the range of a few amperes? How is current established almost the instant a circuit is closed?
(ii) The electron drift arises due to the force experienced by electrons in the electric field inside the conductor. But force should cause acceleration. Why do the electrons acquire a steady average drift speed?
(iii) If the electron drift speed is so small, and the electron's charge is small, how can we still obtain large amounts of current in a conductor?
(iv) 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?
(v) Are the paths of electrons straight lines between successive collisions (with the positive ions of the metal) in the (a) absence of electric field, (b) presence of electric field?

Answer : (i) As soon as a circuit is closed, everywhere in conductor, electric field is set up (with the speed of light), and conduction electron at every point experiences a drift.
(ii) Each conduction electron does accelerate, and gain speed until it collides with a positive ion of a conductor, thereby loosing its drift speed after collision again it gains kinetic energy but suffers a collision again and so on. Therefore on the average, electron acquire only a drift speed
(iii) As number of the density of electrons $\left(\approx 10^{29}\text{ m}^{-3}\right)$ is very large, therefore current flowing is large.
(iv) No.
When electric field is applied, the net drift of the electrons is from lower to higher potential. But locally electrons collide with ions and may change its direction during the course of their motion.
(v) Yes. In the (a) absence of electric field, the paths are straight lines.
Reason: As electrons were not acted upon by any kind of forces.
(b) No. In the presence of electric field paths were curved. Reason: As direction of random velocities and acceleration are not always same.

120) A student while doing experiment connected six wire (600 cm) potentiameter to a cell of emf E, and a key, so that 50 mA current started flowing from A to B. Here A and B are two ends of a potentiameter wire. For a cell of emf 2 V and internal resistance 10 Ω, he found null point at 500 cm from A. But when he connected voltmeter across the cell, the balancing length is decreased by 10 cm.



(i) What is the potential gradient along the wire?
(ii) Reading of voltmeter is ______
(iii) Determine the resistance of voltmeter.
(iv) Now, instead of a cell, if only voltmeter is connected with one end to point A and another end to sliding contact then plot variation of potential difference against length as sliding contact moves away from A. Which physical quantity will represent slope of this graph?

Answer : (i) (i) Potential gradient $= \frac{\text{emf}}{\text{balancing length}}$

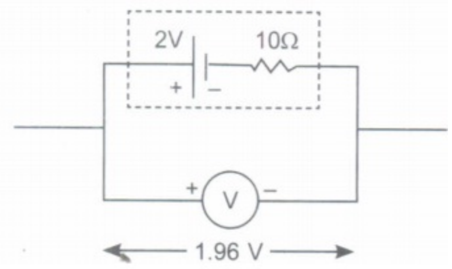
$= \frac{2\text{ V}}{5\text{ m}}$ [∵1 = 500 cm = 5 m]

$k = \frac{2}{5}\text{Vm}^{-1}$

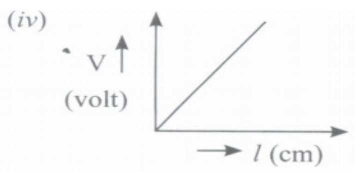
(ii) Voltmeter Reading = V = k l'; l' = 490 cm
= 4.9 m

$\therefore \quad V = \frac{2}{5} \times 4.9 = 1.96\text{ V}$

(iii) When voltmeter is connected across the cell

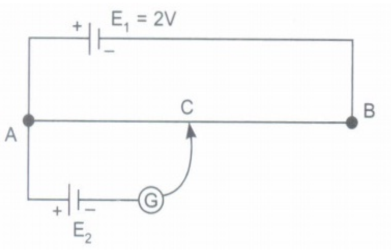


If current through voltmeter is I, then P.D. across the cell is given by
V = E -lr
1.96 = 2.0 - I x 10
I = 0.004 A



Slope $= \frac{\Delta V}{\Delta l} = k =$ Potential gradient

121) AB is a metre long wire of a potentiometer. On connecting a cell E_2 across AC (AC = 60 cm), no current flows from E_2 If internal resistance of cell E. is assumed to be negligible, then determine



(i) Potential gradient along wire AB.
(ii) EMF of cell E_2
(iii) Will balancing point change if E_2 has same internal resistance?

Answer : (i) $V_{AB} = E_1$ = 2V [r_1 = 0]
l_{AB} = 1 m
∴ Potential gradient

$k = \frac{V_{AB}}{l_{AB}} = \frac{2\text{ V}}{1\text{ m}}$

∴ k = 2 Vm^{-1}
(ii) I_{Ac} = 60cm = 0.6m [given]
and E_2 is balanced against l_{AC}

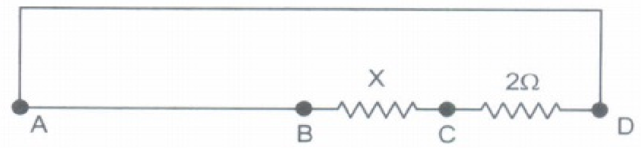
$\therefore\ k = \frac{E_2}{0.6} = 2$

$\Rightarrow E_2 = 1.2\text{ V}$

(iii) No. As no current flows through E_2 at the balancing condition.

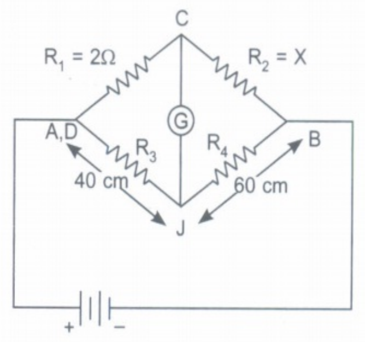
122) (i) AB is a metre long wire having uniform cross sectional area. An unknown resistance X and a resistance of 2 Ω are connected by thick conducting strips. Connect a battery and a galvanometer to

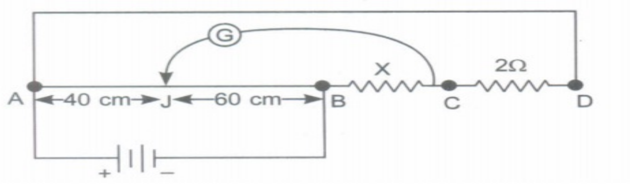
measure unknown resistance X using Wheatstone bridge principle.



(ii) Assuming all the connections to be correct, if balance point is obtained at 40 cm from point A, then what is the value of resistance X?
(iii) If one more resistance of 6Ω is connected in parallel to X, then determine the balancing length.

Answer : (i) Let J be the null point. Then





(ii) Here AJ = 40 cm = 0040 m
JB = 60 cm = 0.60 m
If resistance gradient is r Ω m^{-1}
then resistance of wire of length AJ is R_3 = r x 0.4 Ω
then resistance of wire of length ill is R_4 = r x 0.6 Ω
$\therefore$ According to Wheatstone Bridge Principle, at balancing point

$$\frac{R_1}{R_2} = \frac{R_3}{R_4}$$

$$\frac{2}{X} = \frac{0.4r}{0.6r}$$

or X = 3 Ω
(iii) If 6Ω is connected in parallel to X = 3Ω then, equivalent resistance in parallel is given by

$$X_P = \frac{3\times6}{3+6} = 2\Omega$$

Now R_1 = 2Ω, R_2 = Xp = 2 Ω
R_3 = rl, R_4 = r(100-1)
here l = balancing length

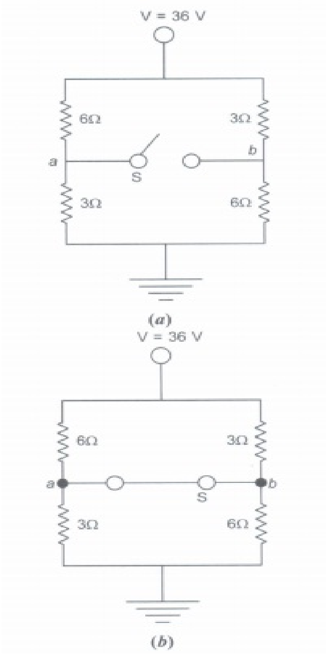
$$\therefore \frac{R_1}{R_2} = \frac{R_3}{R_4}$$

$$\Rightarrow \frac{2}{2} = \frac{rl}{r(100-l)}$$

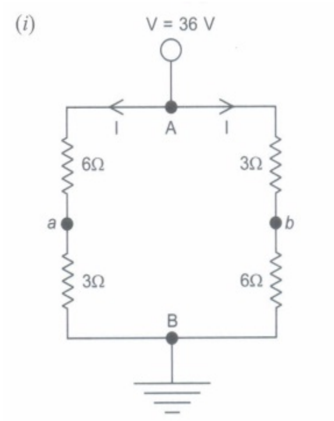
$\therefore$100- l = l
l = 50 cm.

123) In the figure given below, the battery (or other power supply) is not shown, but it is understood that the point at the top, labeled "36V", is connected to the positive terminal of a 36 V battery having negligible internal resistance, and the "ground" symbol at the bottom to its negative terminal. The circuit is completed through the battery, even though it is not shown on the diagram.
(i) In figure (a) what is the potential difference V_a - V_b when switch S is open?

(ii) What is the current through switch S, when it is closed?



Answer :



Voltage at A V_A = 36 V

If I is current through each branch, then

$$I = \frac{36}{6+3} = 4\ A$$

$\therefore$ V_A - V_a = 6I

36 - V_a = 6 x 4

v_a = 36 - 24 = 12V

and V_A -V_b = 3I

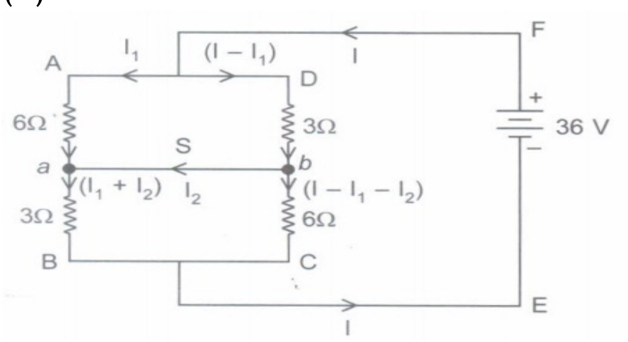
36 - V_b = 3 x 4

36 - V_b = 3 x 4

V_b = 36 - 12 = 24V

V_a-V_b = 12 - 24 = -12V

(ii) When switch S is closed



Using Kirchoff's loop rule in loop AabDA

$6I_1 + 3(I - I_1) = 0$

$\Rightarrow$ $3I = 9I_1$

$\Rightarrow I = 3I_1$ ...(i)