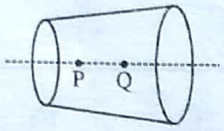
Microscopic analysis

1. A wire has a non-uniform cross-section as shown in figure. A steady current flows through it. The drift speed of electrons at points P and Q is v_P and v_Q.



(A) $v_P = v_Q$ (B) $v_P < v_Q$ (C) $v_P > v_Q$ (D) Data insufficient

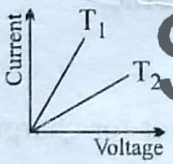
2. Two wires each of radius of cross section r but of different materials are connected together end to end (in series). If the densities of charge carriers in the two wires are in the ratio 1 : 4, the drift velocity of electrons in the two wires will be in the ratio:

(A) 1 : 2 (B) 2 : 1 (C) 4 : 1 (D) 1 : 4

3. An insulating pipe of cross-section area 'A' contains an electrolyte which has two types of ions→ their charges being –e and +2e. A potential difference applied between the ends of the pipe result in the drifting of the two types of ions, having drift speed = v (–ve ion) and v/4 (+ve ion). Both ions have the same number per unit volume = n. The current flowing through the pipe is

(A) nev A/2 (B) nev A/4 (C) 5nev A/2 (D) 3nev A/2

4. The current in a metallic conductor is plotted against voltage at two different temperatures T_1 and T_2. Which is correct :-



(A) $T_1 > T_2$ (B) $T_1 < T_2$ (C) $T_1 = T_2$ (D) none

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

(A) maximum when the battery is connected across 1 cm × $\frac{1}{2}$ cm faces.

(B) maximum when the battery is connected across 10 cm × 1 cm faces.

(C) maximum when the battery is connected across 10 cm × $\frac{1}{2}$ cm faces.

(D) same irrespective of the three faces.

6. 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

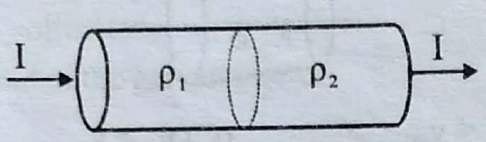
(A) source of emf.

(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.

7. Two long straight cylindrical conductors with resistivities ρ_1 and ρ_2 respectively are joined together as shown in figure. If current I flows through the conductors, the magnitude of the total free charge at the interface of the two conductors is :-



(A) zero (B) $\frac{(\rho_1-\rho_2)I\varepsilon_0}{2}$ (C) $\varepsilon_0 I|\rho_1-\rho_2|$ (D) $\varepsilon_0 I|\rho_1+\rho_2|$

8. **Statement 1 :** The drift speed of electrons in metals is small (in the order of a few mm/s) and the charge of an electron is also very small ($= 1.6 \times 10^{-19}$C), yet we can obtain a large current in a metal.

and

Statement 2: At room temperature, the thermal speed of electron is very high (about 10^7 times the drift speed).

(A) Statement–1 is True, Statement–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.

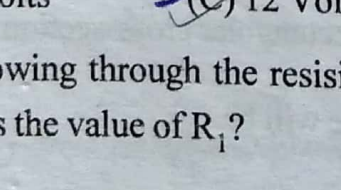
(D) Statement–1 is False, Statement–2 is True.

Ohm's law & circuit analysis

9. A storage battery is connected to a charger for charging with a voltage of 12.5Volts. The internal resistance of the storage battery is 1Ω. When the charging current is 0.5 A, the emf of the storage battery is:

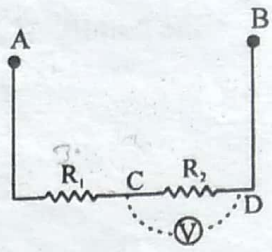
(A) 13 Volts (B) 12.5 Volts (C) 12 Volts (D) 11.5 Volts

10. In the given circuit the current flowing through the resisitance 20 ohms is 0.3 ampere while the ammetre reads 0.8 ampere. What is the value of R_1?



(A) 30 ohms (B) 40 ohms (C) 50 ohms (D) 60 ohms

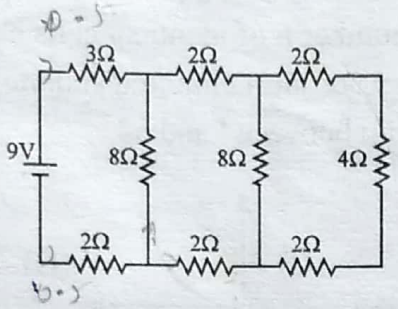
11. Resistances R_1 and R_2 each 60Ω are connected in series as shown in figure. The Potential difference between A and B is kept 120 volt. Then what will be the reading of voltmeter connected between the point C & D if resistance of voltmeter is 120Ω.



(A) 48 V (B) 24 V

(C) 40V (D) None

12. In the circuit shown in the figure, the current through :



(A) the 3Ω resistor is 0.50 A (B) the 3Ω resistor is 0.25 A

(C) 4 Ω resistor is 0.50 A (D) the 4Ω resistor is 0.25 A

13. A simple circuit contains an ideal battery and a resistance R. If a second resistor is placed in parallel with the first,

(A) the potential across R will decrease

(B) the current through R will decreased

(C) the current delivered by the battery will increase

(D) the power dissipated by R will increased.

14. The equivalent resistance of a group of resistances is R. If another resistance is connected in parallel to the group , its new equivalent becomes R_1 & if it is connected in series to the group , its new equivalent becomes R_2 we have :

(A) $R_1 > R$ (B) $R_1 < R$ (C) $R_2 > R$ (D) $R_2 < R$

15. An energy source will supply a constant current into the load, if its internal resistance is-

[AIEEE - 2005]

(A) equal to the resistance of the load (B) very large as compared to the load resistance

(C) zero (D) non-zero but less than the resistance of the load

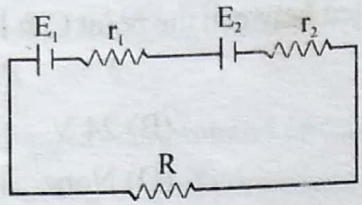
16. When a current of 4 A flows within a battery from its positive to negative terminal, the potential difference across the battery is 12 volts. The potential difference across the battery is 9 volts when a current of 2 A flows within it from its negative to its positive terminal. The internal resistance and the e.m.f. of the battery are :-

(A) 0.1 Ω, 4V (B) 0.2 Ω, 5V (C) 0.5 Ω, 10V (D) 0.7 Ω, 10V

17. Two resistances of equal magnitude R and having temperature coefficient α_1 and α_2 respectively are connected in parallel. The temperature coefficient of the parallel combination is, approximately

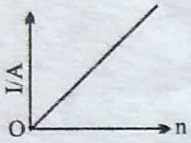
(A) $2(\alpha_1 + \alpha_2)$ (B) $\frac{\alpha_1\alpha_2}{\alpha_1 + \alpha_2}$ (C) $\frac{\alpha_1 - \alpha_2}{2}$ (D) $\frac{\alpha_1 + \alpha_2}{2}$

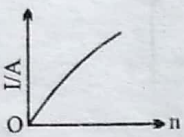
18. Under what condition current passing through the resistance R can be increased by short circuiting the battery of emf E_2. The internal resistances of the two batteries are r_1 and r_2 respectively.

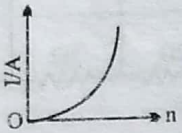


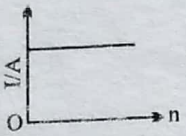
(A) $E_2r_1 > E_1(R + r_2)$ (B) $E_1r_2 > E_2(R + r_1)$ (C) $E_2r_2 > E_1(R + r_2)$ (D) $E_1r_1 > E_2(R + r_1)$

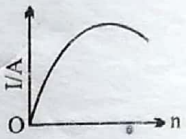
19. A battery consists of a variable number n of identical cells having internal resistance connected in series. The terminals of the battery are short circuited and the current I measured. Which one of the graph below shows the relationship between I and n?

(A) 

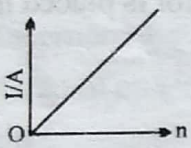
(B) 

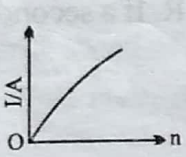
(C) 

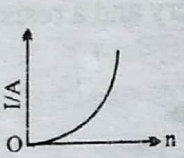
(D) 

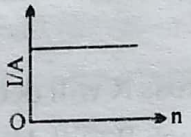
(E) 

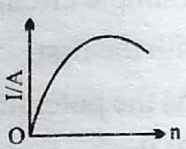
20. In **previous problem**, if the cell had been connected in parallel (instead of in series) which of the above graphs would have shown the relationship between total current I and n?

(A) 

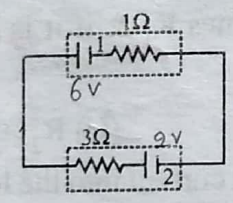
(B) 

(C) 

(D) 

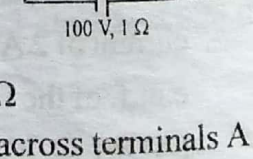
(E) 

21. In the figure shown, battery 1 has emf = 6 V and internal resistance = 1 Ω. Battery 2 has emf = 2V and internal resistance = 3 Ω. The wires have negligible resistance. What is the potential difference across the terminals of battery 2 ?



(A) 4 V (B) 1.5 V (C) 5 V (D) 0.5 V

22. The battery in the diagram is to be charged by the generator G. The generator has a terminal voltage of 120 volts when the charging current is10 amperes. The battery has an emf of 100 volts and an internal resistance of 1 ohm. In order to charge the battery at 10 amperes charging current, the resistance R should be set at :-

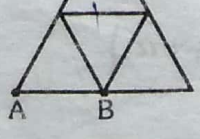


(A) 0.1 Ω (B) 0.5 Ω (C) 1.0 Ω (D) 5.0 Ω

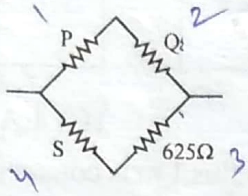
23. In the diagram resistance between any two junctions is R. Equivalent resistance across terminals A and B is :-

(A) $\frac{11R}{7}$ (B) $\frac{18R}{11}$

(C) $\frac{7R}{11}$ (D) $\frac{11R}{18}$



24. A Wheatstone's bridge is balanced with a resistance of 625 Ω in the third arm, where P, Q and S are in the 1st, 2nd and 4th arm respectively. If P and Q are interchanged, the resistance in the third arm has to be increased by 51Ω to secure balance. The unknown resistance in the fourth arm is :-

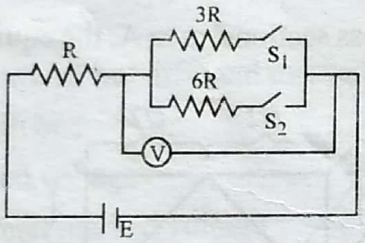


(A) 625 Ω (B) 650 Ω (C) 676 Ω (D) 600 Ω

25. One end of a Nichrome wire of length 2L and cross-sectional area A is attatched to an end of another Nichrome wire of length L and cross-sectional area 2A. If the free end of the longer wire is at an electric potential of 8.0 volts, and the free end of the shorter wire is at an electric potential of 1.0 volt, the potential at the junction of the two wires is equal to :-

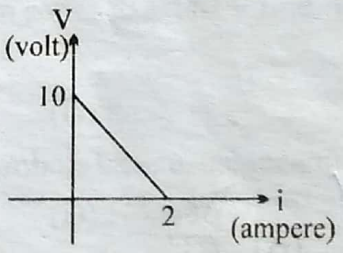
(A) 2.4 V (B) 3.2 V (C) 4.5 V (D) 5.6 V

26. In the circuit shown in figure reading of voltmeter is V_1 when only S_1 is closed, reading of voltmeter is V_2 when only S_2 is closed. The reading of voltmeter is V_3 when both S_1 and S_2 are closed then



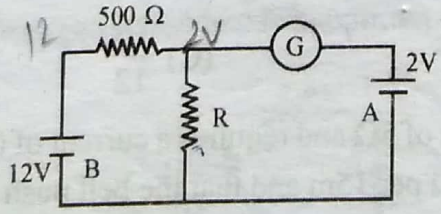
(A) $V_2 > V_1 > V_3$ (B) $V_3 > V_2 > V_1$ (C) $V_3 > V_1 > V_2$ (D) $V_1 > V_2 > V_3$

27. A battery of emf E and internal resistance r is connected across a resistance R. Resistance R can be adjusted to any value greater than or equal to zero. A graph is plotted between the current (i) passing through the resistance and potential difference (V) across it. Select the correct alternative.



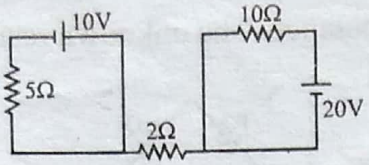
(A) internal resistance of battery is 5Ω
(B) emf of the battery is 20V
(C) maximum current which can be taken from the battery is 4A
(D) V- i graph can never be a straight line as shown in figure.

28. In the circuit, the galvanometer G shows zero deflection. If the batteries A and B have negligible internal resistance, the value of the resistor R will be- **[AIEEE - 2005]**



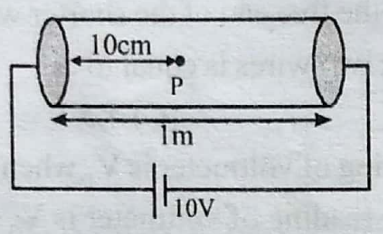
(A) 200 Ω (B) 100 Ω (C) 500 Ω (D) 1000 Ω

29. In the figure shown the current through 2Ω resistor is



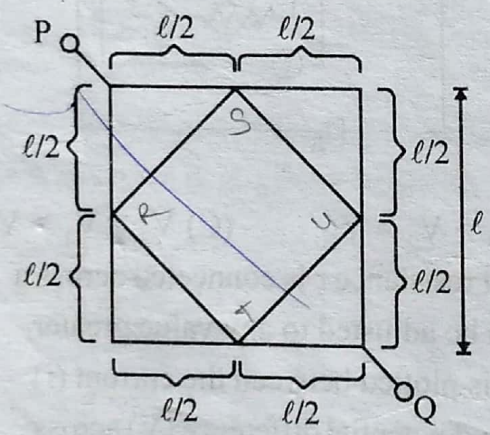
(A) 2 A (B) 0 A (C) 4 A (D) 6 A

30. A cylindrical solid of length 1m and radius 1 m is connected across a source of emf 10V and negligible internal resistance shown in figure. The resistivity of the rod as a function of x (x measured from left end) is given by $\rho = bx$ [where b is a positive constant]. Find the electric field (in SI unit) at point P at a distance 10 cm from left end.



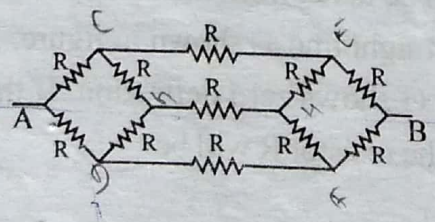
(A) 1 (B) 2 (C) 3 (D) 4

31. If the wire has resistivity ρ and cross sectional area A, the equivalent resistance between P and Q is :-



(A) $\frac{\rho\ell}{\sqrt{2}A}$ (B) $\frac{\sqrt{2}\rho\ell}{A}$ (C) $\frac{2\rho\ell}{A}$ (D) $\frac{\rho\ell}{A}$

32. The equivalent resistance between the terminal points A and B in the network shown in figure is :-

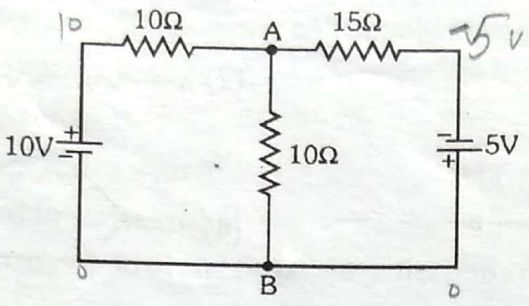


(A) $\frac{7R}{5}$ (B) $\frac{5R}{6}$ (C) $\frac{7R}{12}$ (D) $\frac{5R}{12}$

33. An electric bell has a resistance of 5Ω and requires a current of 0.25 A to work it. Assuming that the resistance of the bell wire is 1Ω per 15m and that the bell push is 90m distance from the bell, How many cells each of emf 1.4V and internal resistance 2Ω, will be required to work the circuit-

(A) 3 (B) 4 (C) 5 (D) Can't be determined

34. A circuit is arranged as shown. Then, the current from A to B is



(A) +500 mA (B) +250 mA (C) –250 mA (D) –500 mA

Joule heating

35. Power generated across a uniform wire connected across a supply is H. If the wire is cut into n equal parts and all the parts are connected in parallel across the same supply, the total power generated in the wire is :-

(A) $\frac{H}{n^2}$ (B) n^2H (C) nH (D) $\frac{H}{n}$

36. When electric bulbs of same power, but different marked voltage are connected in series across the power line, their brightness will be :

(A) proportional to their marked voltage

(B) inversely proportional to their marked voltage

(C) proportional to the square of their marked voltage

(D) inversely proportional to the square of their marked voltage

37. Two bulbs rated (25 W – 220V) and (100W – 220V) are connected in series to a 440 V line. Which one is likely to fuse?

(A) 25 W bulb (B) 100 W bulb (C) both bulbs (D) none

38. Rate of dissipation of Joule's heat in resistance per unit volume is (symbols have usual meaning)

(A) σE (B) σJ (C) $J E$ (D) None

39. If the length of the filament of a heater is reduced by 10%, the power of the heater will

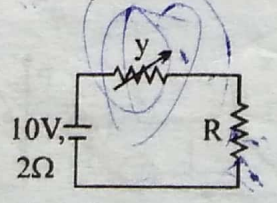
(A) increase by about 9% (B) increase by about 11%

(C) increase by about 19% (D) decrease by about 10%

40. Two bulbs one of 200 volts, 60 watts & the other of 200 volts, 100 watts are connected in series to a 200 volt supply. The power consumed will be

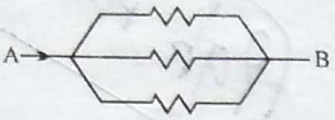
(A) 37.5 watt (B) 160 watt (C) 62.5 watt (D) 110 watt

41. In the figure shown the power generated in y is maximum when y = 5Ω. Then R is :-

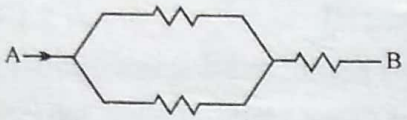


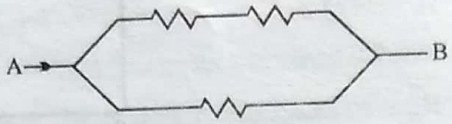
(A) 2 Ω (B) 6 Ω (C) 5 Ω (D) 3 Ω

42. Arrange the order of power dissipated in the given circuits, if the same current is passing through all circuits and each resistor is 'r' **[IIT-JEE' 2003 (Scr)]**

(1) 

(2) 

(3) 

(4) 

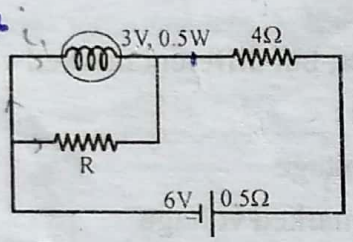
(A) $P_2 > P_3 > P_4 > P_1$ (B) $P_3 > P_2 > P_4 > P_1$

(C) $P_4 > P_3 > P_2 > P_1$ D) $P_1 > P_2 > P_3 > P_4$

43. A rigid container with thermally insulated walls contains a coil of resistance 100 Ω, carrying current 1 A. Change in internal energy after 5 min will be **[IIT-JEE 2005]**

(A) zero (B) 10 kJ (C) 20 kJ (D) 30 kJ

44. The value of the resistance R in the circuit shown below so that electric bulb consumes the rated power is :-



(A) 4 ohm (B) 6 ohm (C) 8 ohm (D) 10 ohm

45. A variable load R is connected to a voltage source of internal resistance r. Then choose the **INCORRECT** statement out of the following :-

(A) If R = r, maximum power is transferred to the load

(B) If current is maximum, power transfer to load is also maximum

(C) If R << r, the voltage source supplied a fixed current to the load

(D) Power supplied to load is minimum if load is either too low or too high

46. The variation of current (I) and voltage (V) is as shown in figure A. The variation of power P with current *I* is best shown by which of the following graph :-

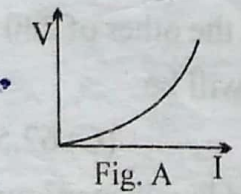
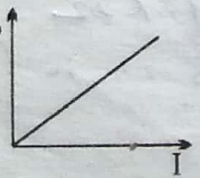
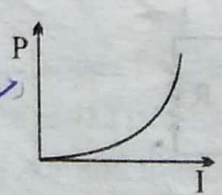
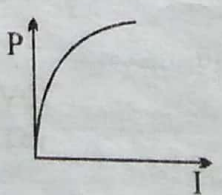
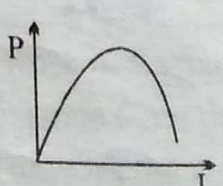


Fig. A

(A) 

(B) 

(C) 

(D) 

Instruments

47. A galvanometer has a resistance of 20Ω and reads full-scale when 0.2 V is applied across it. To convert it into a 10 A ammeter, the galvanometer coil should have a

(A) 0.01Ω resistor connected across it

(B) 0.02Ω resistor connected across it

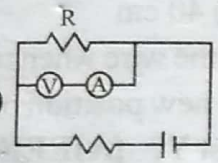
(C) 200Ω resistor connected in series with it

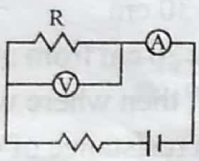
(D) 2000 Ω resistor connected in series with it

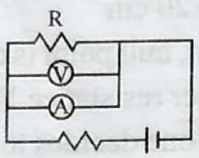
48. A galvanometer coil has a resistance 90 Ω and full scale deflection current 10 mA. A 910Ω resistance is connected in series with the galvanometer to make a voltmeter. If the least count of the voltmeter is 0.1V, the number of divisions on its scale is :

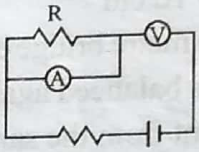
(A) 90 (B) 91 (C) 100 (D) none

49. Which of the following wiring diagrams could be used to experimentally determine R using ohm's law? Assume an ideal voltmeter and an ideal ammeter.

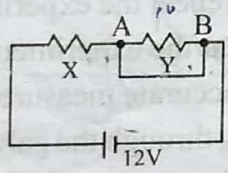
(A) 

(B) 

(C) 

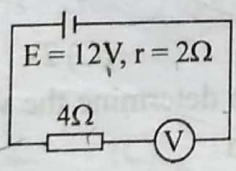
(D) 

50. When an ammeter of negligible internal resistance is inserted in series with circuit it reads 1A. When the voltmeter of very large resistance is connected across X it reads 1V. When the point A and B are shorted by a conducting wire, the voltmeter measures 10 V across the battery. The internal resistance of the battery is equal to :-



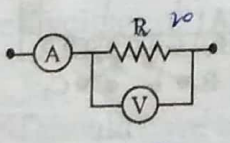
(A) zero (B) 0.5 Ω (C) 0.2 Ω (D) 0.1 Ω

51. By error, a student places moving-coil voltmeter V (nearly ideal) in series with the resistance in a circuit in order to read the current, as shown. The voltmeter reading will be



(A) 0 (B) 4V (C) 6V (D) 12V

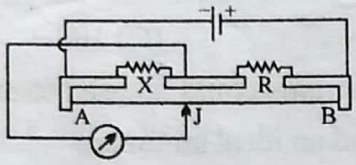
52. In the circuit shown the readings of ammeter and voltmeter are 4A and 20V respectively. The meters are non ideal, then R is :



(A) 5Ω (B) less than 5Ω (C) greater than 5Ω (D) between 4Ω & 5Ω

53. In a balanced wheat stone bridge, current in the galvanometer is zero. It remains zero when:
[1] battery emf is increased
[2] all resistances are increased by 10 ohms
[3] all resistances are made five times
[4] the battery and the galvanometer are interchanged
(A) only [1] is correct (B) [1], [2] and [3] are correct
(C) [1], [3] and [4] are correct (D) [1] and [3] are correct

54. The figure shows a metre-bridge circuit, with AB = 100 cm, X = 12Ω and R = 18Ω, and the jockey J in the position of balance. If R is now made 8Ω, through what distance will J have to be moved to obtain balance?

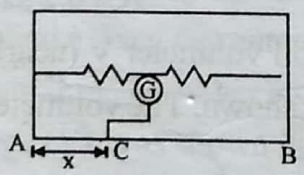


(A) 10 cm (B) 20 cm (C) 30 cm (D) 40 cm

55. In a metre bridge experiment, null point is obtained at 20 cm from one end of the wire when resistance X is balanced against another resistance Y. If X < Y, then where will be the new position of the null point from the same end, if one decides to balance a resistance of 4X against Y? **[AIEEE - 2004]**
(A) 50 cm (B) 80 cm (C) 40 cm (D) 70 cm

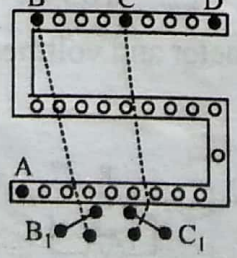
56. A resistance *R* is to be measured using a meter bridge. Student chooses the standard resistance *S* to be 100Ω. He finds the null point at $l_1 = 2.9$ cm. He is told to attempt to improve the accuracy. Which of the following is a useful way?
(A) He should measure l_1 more accurately.
(B) He should change *S* to 1000Ω and repeat the experiment.
(C) He should change *S* to 3Ω and repeat the experiment.
(D) He should give up hope of a more accurate measurement with a meter bridge.

57. In the given circuit, no current is passing through the galvanometer. If the cross-sectional diameter of AB is doubled then for null point of galvanometer the value of AC would : **[IIT-JEE' 2003 (Scr)]**



(A) x (B) x/2 (C) 2x (D) None

58. For the post office box arrangement to determine the value of unknown resistance, the unknown resistance should be connected between **[IIT-JEE' 2004 (Scr)]**



(A) *B* and *C* (B) *C* and *D* (C) *A* and *D* (D) B_1 and C_1

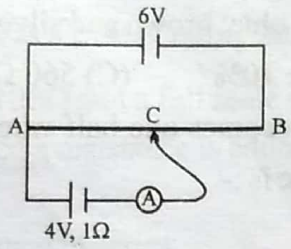
59. The sensitivity of post–office box for determination of resistance of 5Ω is maximum when, P and Q both are :-

(A) 1 Ω (B) 10 Ω (C) 100 Ω (D) 1000 Ω

60. A potentiometer wire has length 10 m and resistance 10Ω. It is connected to a battery of EMF 11 volt and internal resistance 1 Ω, then the potential gradient in the wire is :-

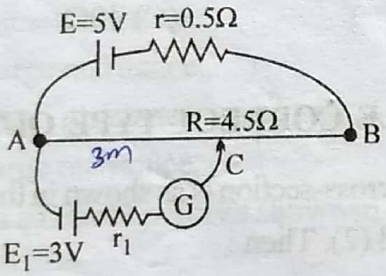
(A) 10 V/m (B) 1 V/m (C) 0.1 V/m (D) none

61. A 6 V battery of negligible internal resistance is connected across a uniform wire of length 1 m. The positive terminal of another battery of emf 4V and internal resistance 1 Ω is joined to the point A as shown in figure. The ammeter shows zero deflection when the jockey touches the wire at the point C. The AC is equal to :-



(A) 2/3 m (B) 1/3 m (C) 3/5 m (D) 1/2 m

62. In the given potentiometer circuit length of the wire AB is 3 m and resistance is R = 4.5 Ω. The length AC for no deflection in galvanometer is :-



(A) 2 m (B) 1.8 m (C) dependent on r_1 (D) none of these

63. The length of a potentiometer wire is ℓ. A cell of emf E is balanced at a length $\ell/3$ from the positive end of the wire. If the length of the wire is increased by $\ell/2$. At what distance will the same cell give a balance point.

(A) $\frac{2\ell}{3}$ (B) $\frac{\ell}{2}$ (C) $\frac{\ell}{6}$ (D) $\frac{4\ell}{3}$

64. Two cells of emf's approximately 5V and 10V are to be accurately compared using a potentiometer of length 400cm.

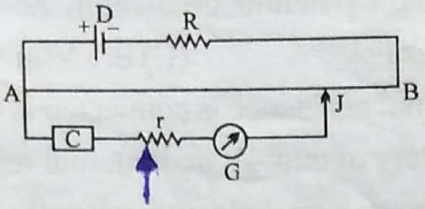
(A) The battery that runs the potentiometer should have voltage of 8V.

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

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

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

65. In the given potentiometer circuit, the resistance of the potentiometer wire AB is R_0. C is a cell of internal resistance r. The galvanometer G does not give zero deflection for any position of the jockey J. Which of the following cannot be a reason for this ?



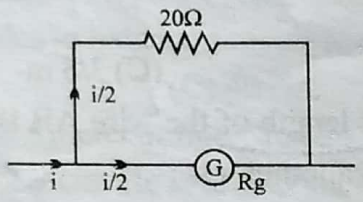
(A) $r > R_0$ (B) $R >> R_0$

(C) emf of C > emf of D (D) The negative terminal of C is connected to A.

66. A resistor has a color code of green, blue; brown and silver. What is its resistance?

(A) 56 Ω ± 5% (B) 560 Ω ± 10% (C) 560 Ω ± 5% (D) 5600 Ω ± 10%

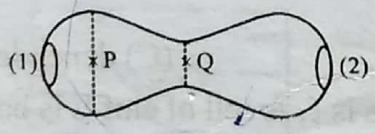
67. In a galvanometer, the deflection becomes one half when the galvanometer is shunted by a 20Ω resistor. The galvanometer resistance is :-



(A) 5Ω (B) 10Ω (C) 40Ω (D) 20Ω

MULTIPLE CORRECT TYPE QUESTIONS

68. A metallic conductor of irregular cross-section is as shown in the figure. A constant potential difference is applied across the ends (1) and (2). Then :



(A) the current at the cross-section P equals the current at the cross-section Q

(B) the electric field intensity at P is less than that at Q.

(C) the rate of heat generated per unit time at Q is greater than that at P

(D) the number of electrons crossing per unit area of cross-section at P is less than that at Q.

69. A current passes through an ohmic conductor of nonuniform cross section. Which of the following quantities are independent of the cross-section?

(A) the charge crossing in a given time interval.

(B) drift speed

(C) current density

(D) free-electron density

70. A battery is of emf E is being charged from a charger such that positive terminal of the battery is connected to terminal A of charger and negative terminal of the battery is connected to terminal B of charger. The internal resistance of the battery is r.

(A) Potential difference across points A and B must be more than E.

(B) A must be at higher potential than B

(C) In battery, current flows from positive terminal to the negative terminal

(D) No current flows through battery

71. Two identical fuses are rated at 10A. If they are joined

(A) in parallel, the combination acts as a fuse of rating 20A

(B) in parallel, the combination acts as a fuse of rating 5A

(C) in series, the combination acts as a fuse of rating 10A.

(D) in series, the combination acts as a fuse of rating 20A.

72. A micrometer has a resistance of 100Ω and a full scale range of 50μA. It can be used as a voltmeter or a higher range ammeter provided a resistance is added to it. Pick the correct range and resistance combination(s).

(A) 50 V range with 10 kΩ resistance in series.

(B) 10 V range with 200 kΩ resistance in series.

(C) 5 mA range with 1 Ω resistance in parallel.

(D) 10 mA range with 1 kΩ resistance in parallel.

73. Mark out the correct options.

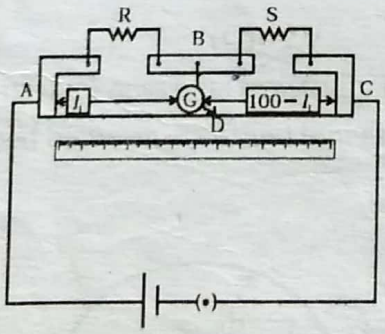
(A) An ammeter should have small resistance.

(B) An ammeter should have large resistance.

(C) A voltmeter should have small resistance.

(D) A voltmeter should have large resistance.

74. In a meter bridge the point D is a neutral point as shown in figure.



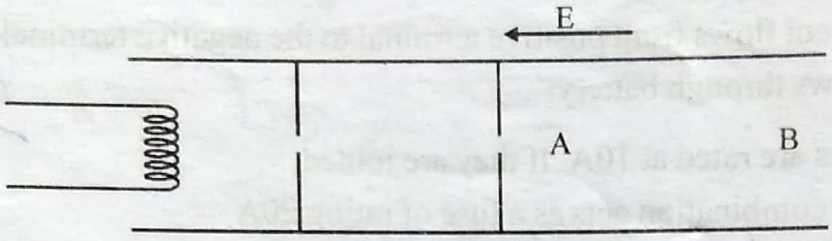
(A) The meter bridge can have no other neutral point for this set of resistances.

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

(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.

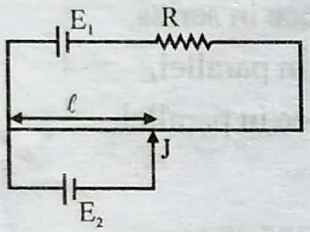
(D) When *R* is increased, the neutral point shifts to left.

75. Electrons are emitted by a hot filament and are accelerated by an electric field as shown in figure. The two stops at the left ensure that the electron beam has a uniform cross-section. Match the entries of column-I with column-II as electron move from A to B :



	Column-I		**Column-II**
(A)	Speed of an electron	(P)	Inreases
(B)	Number of free electrons per unit volume	(Q)	Decreases
(C)	Current density	(R)	Remains same
(D)	Electric potential	(S)	any of the above is possible

76. In the potentiometer arrangement shown in figure, null point is obtained at length ℓ.



	Column-I		**Column-II**
(A)	If E_1 is increased	(P)	ℓ should increase
(B)	If R is increased	(Q)	ℓ should decrease
(C)	If E_2 is increased	(R)	ℓ should remain the same to again get the null point