Subject : (Physics) **Current Electricity** Batch : One Year Batch

1. Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area 1.0×10^{-7} m^2 carrying a current of 1.5 A. Assume that each copper atom contributes roughly one conduction electron. The density of copper is 9.0×10^3 kg m^{-3} and its atomic mass is 63.5 u.

2. An electron beam after being accelerated from rest through a potential difference of 500 V in vacuum is allowed to impinge normally on a fixed surface. If the incident current is 100 μA, determine theforce exerted on the surface assuming that it brings the electrons to rest.

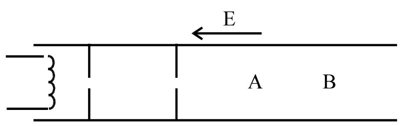
3. The drift velocity of electrons in a conducting wire is of the order of 1mm/s, yet the bulb glows very quickly after the switch is put on because

(A) the random speed of electrons is very high, of the order of 10^6 m/s
(B) the electrons transfer their energy very quickly through collisions
(C) electric field is set up in the wire very quickly, producing a current through each cross section, almost intantaneousty
(D) All of above

4. In the presence of an applied electric field ($\vec{E}$) in a metallic conductor.

(A) The electrons move in the direction of $\vec{E}$
(B) The electrons move in a direction opposite to $\vec{E}$
(C) The electrons may move in any direction randomly, but slowly drift in the direction of $\vec{E}$.
(D) The electrons move randomly but slowly drift in a direction opposite to $\vec{E}$.

5. Electrons are emitted by a hot filament and are accelerated by an electric field as shown in fig. The two stops at the left ensure that the electron beam has a uniform cross-section.

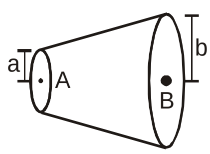


(A) The speed of the electron is more at B than at A.
(B) The electric current is from left to right
(C) The magnitude of the current is larger at B than at A.
(D) The current density is more at B than at A.

6. A 150 m long metal wire connects points A and B. The electric potential at point B is 50 V less than that at point A. If the conductivity of the metal is 60×10^6 mho/m, then magnitude of the current density in the wire is equal to :

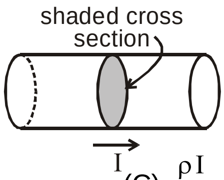
(A) 11×10^{-4} A/m^2 (B) 5.5×10^{-3} A/m^2 (C) 4×10^7 A/m^2 (D) 20×10^6 A/m^2

7. An electric current passes through non uniform cross-section wire made of homogeneous and isotropic material. If the j_A and j_B be the current densities and E_A and E_B be the electric field intensities at A and B respectively, then



(A) $j_A > j_B$; $E_A > E_B$ (B) $j_A > j_B$; $E_A < E_B$ (C) $j_A < j_B$; $E_A > E_B$ (D) $j_A < j_B$; $E_A < E_B$

8. A current I flows through a cylindrical rod of uniform cross-section area A and resistivity ρ. The electric flux through the shaded cross-section of rod as shown in figure is :

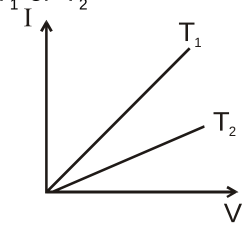


(A) $\frac{I}{\rho}$ (B) ρI (C) $\frac{\rho I}{A}$ (D) $\frac{\rho A}{I}$

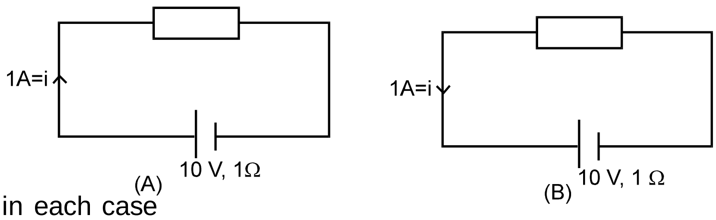
9. **(i)** A potential difference of 200 volt is applied to a coil at a temperature of 15ºC and the current is 10 A. What will be the mean temperature of the coil when the current has fallen to 9 A, the applied voltage being the same as before? temperature coefficient of resistance $(\alpha)=\frac{1}{234}$ ºC^{-1}

(ii) A platinum wire has resistance of 10 ohm at 0ºC and 20 ohm at 273 ºC. Find the value of temperature coefficient of resistance.

10. The current-voltage graphs for a given metallic wire at two different temperature T_1 and T_2 are shown in the figure. Which one is higher, T_1 or T_2



11. In following diagram boxes may contain resistor or battery or any other element



then determine in each case

(a) E.m.f. of battery

(b) Battery is acting as a source or load

(c) Potential difference across each battery

(d) Power input to the battery or output by the battery.

(e) The rate at which heat is generated inside the battery.

(f) The rate at which the chemical energy of the cell is consumed or increased.

(g) Potential difference across box

(h) Electric power output across box.

12. (a) A car has a fresh storage battery of emf 12 V and internal resistance 5.0×10^{-2} Ω. If the starter draws a current of 90 A, what is the terminal voltage of the battery when the starter is on ?

(b) After long use, the internal resistance of the storage battery increases to 500 Ω. What maximum current can be drawn from the battery? Assume the emf of the battery to remain unchanged.

(c) If the discharged battery is charged by an external emf source, is the terminal voltage of the battery during charging greater or less than its emf 12 V?

13. In an electric circuit containing a battery, the positive charge inside the battery

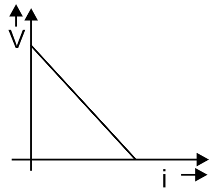
(A) always goes from the positive terminal to the negative terminal

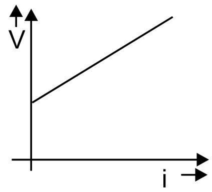
(B) may go from the positive terminal to the negative terminal

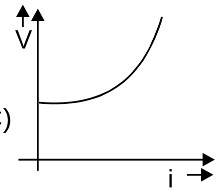
(C) always goes from the negative terminal to the positive terminal

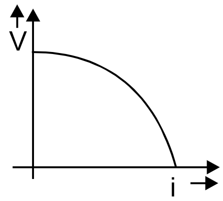
(D) does not move.

14. If internal resistance of a cell is proportional to current drawn from the cell. Then the best representation of terminal potential difference of a cell with current drawn from cell will be:

(A) 

(B) 

(C) 

(D) 

15. A bulb is connected to an ideal battery of emf 10 V so that the resulting current is 10 mA. When the bulb is connected to 220 V mains (ideal), the current is 50 mA. Choose the correct alternative (s)

(A) In the first case, the resistance of the bulb is 1kΩ and in second case, it is 4.4 kΩ.

(B) It is not possible since ohm's law is not followed

(C) the increase in resistance is due to heating of the filament of the bulb when it is connected to 220 V mains

(D) None of these

16. Choose the correct alternatives

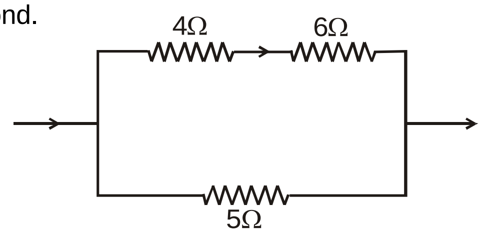
(A) It is easier to start a car engine on a warm day than on a chilly cold day because the internal resistance of battery decreases with rise in temperature

(B) It is more economical to transmit electric power at high voltage and low current rather than at low voltage and high current because heat loss is proportional to square of current.

(C) The heating coil of an electric iron is enclosed in mica sheets because mica is a bad conductor of heat and good conductor of electricity

(D) The heating coil of an electric iron is enclosed in mica sheets because mica is a good conductor of heat and bad conductor of electricity.

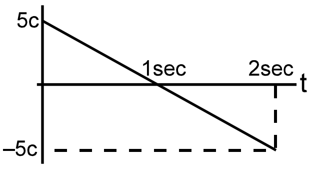
17. In the circuit shown in figure the heat produced in the 5Ω resistor due to the current flowing through it is 10 calories per second.

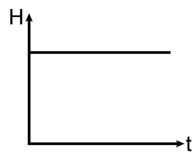


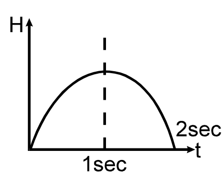
The heat generated in the 4Ω resistor is :

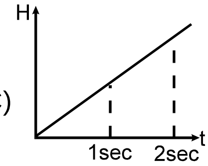
(A) 1 cal/s (B) 2 cal/s (C) 3 cal/s (D) 4 cal/s

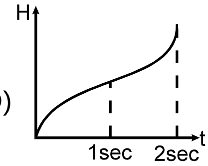
18. A charge passing through a resistor is varying with time as shown in the figure. The amount of heat generated in time ' t ' is best represented (as a function of time) by:



(A) 

(B) 

(C) 

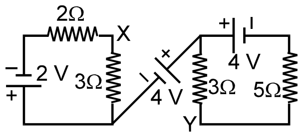
(D) 

19. The charge flown through a resistance R in time t varies with time according to $Q = at - bt^2$. The total heat produced in R by the time current becomes zero is :

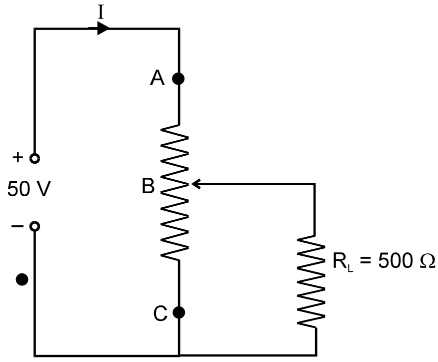
(A) $\frac{a^3R}{6b}$ (B) $\frac{a^3R}{2b}$ (C) $\frac{a^3R}{3b}$ (D) $\frac{a^3R}{b}$

20. (a) Determine the potential drop between X and Y in the circuit shown in Figure.

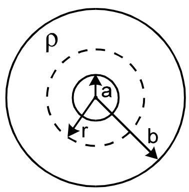
(b) If intermediate cell has internal resistance r = 1Ω then determine the potential difference between x and y.



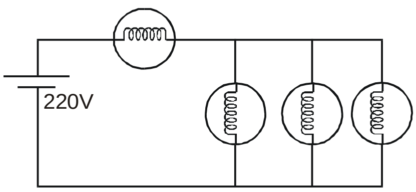
21. As shown in figure a variable rheostat of 2 kΩ is used to control the potential difference across 500 ohm load. (i) If the resistance AB is 500 Ω, what is the potential difference across the load ? (ii) If the load is removed, what should be the resistance at BC to get 40 volt between B and C ?



22. Two concentric thin conducting shells of radii a and b are as shown in the figure. The region inside the shells is filled with a medium of resistivity ρ. The conducting spheres are given equal and opposite charges. The electric flux through the surface of a spherical region (indicated by dotted region) of radius r is ϕ. Find the current crossing the dotted spherical surface of radius r.

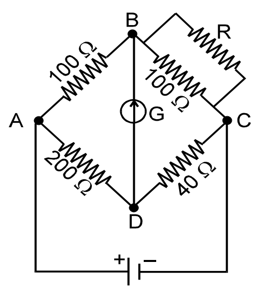


23. Four identical bulbs each rated 100 watt, 220 volts are connected across a battery as shown. The total electric power consumed by the bulbs is:



(A) 75 watt (B) 400 watt (C) 300 watt (D) 400/3 watt

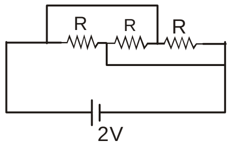
24. The given Wheatstone bridge is showing no deflection in the galvanometer joined between the points B and D (Figure). Calculate the value of R.



(A) 25 Ω (B) 50 Ω

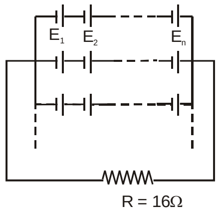
(C) 40 Ω (D) 100 Ω

25. Three equal resistance each of R ohm are connected as shown in figure. A battery of 2 volts of internal resistance 0.1 ohm is connected across the circuit. Calculate the value of R for which the heat generated in the external circuit is maximum.



(A) 0.1 Ω (B) 0.2 Ω (C) 0.3 Ω (D) 0.4 Ω

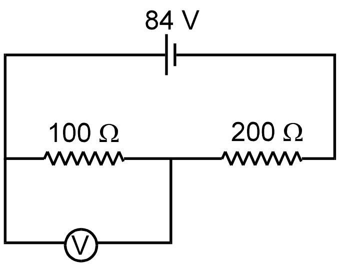
26. 300 nos. of identical galvanic cells, each of internal resistance 9Ω are arranged as several in–series groups of cells connected in parallel. The arrangement has been laid out so that power output in an externally connected resistance of value 16 Ω is maximum. If n number of cells are connected in every series group that form parallel combination, then find value of n.



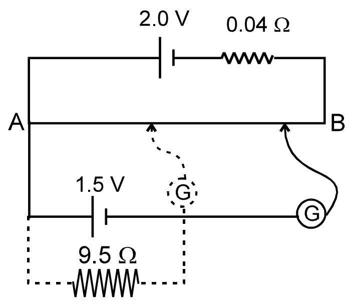
27. 12 cells each having the same emf are connected in series and are kept in a closed box. Some of the cells are wrongly connected. This battery is connected in series with an ammeter and two cells identical with each other and also identical with the previous cells. The current is 3 A when the external cells aid this battery and is 2 A when the cells oppose the battery. How many cells in the battery are wrongly connected?

(A) one (B) two (C) three (D) none

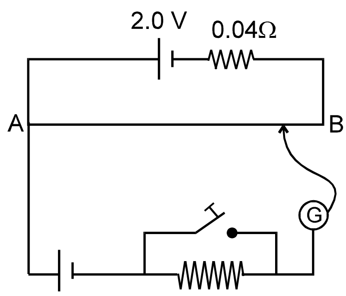
28. A voltmeter of resistance 400Ω is used to measure the potential difference across the 100Ω resistor in the circuit shown in the figure. (a) What will be the reading of the voltmeter ? (b) What was the potential difference across 100 Ω before the voltmeter was connected ?



29. Figure shows a 2.0 V potentiometer used for the determination of internal resistance of 1.5 V cell. The balance point of the cell in open circuit is 70 cm. When a resistor of 9.5 Ω is used in the external circuit of the cell, the balance point shifts to 60 cm length of the potentiometer wire. Determine the internal resistance of the secondary cell.



30. Figure shows a potentiometer with a cell of emf 2.0 V and internal resistance 0.04 Ω maintaining a potential drop across the potentiometer wire AB. A standard cell which maintains a constant emf of 1.02 V (for very moderate currents up to a few ampere) gives a balance point of 67.3 cm length of the wire. To ensure very low currents drawn from the standard cell, a very high resistance of 600 kΩ is put in series with it which is shorted close to the balance point. The standard cell is then replaced by a cell of unknown emf



E and the balance point found similarly turns out to be at 82.3 cm length of the wire.

(a) What is the value of E ?

(b) What purpose does the high resistance of 600 kΩ have ?

(c) Is the balance point affected by this high resistance?

(d) Is the balance point affected by the internal resistance of the driver cell?

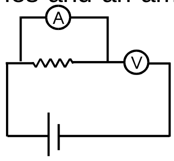
(e) Would the method work in the above situation if the driver cell of the potentiometer had an emf of 1.0 V instead of 2.0 V?

(f) Would the circuit work well for determining extremely small emf, say, of the order of few mV (such typical emf of thermocouple)?

31. In a potentiometer wire experiment the emf of a battery in the primary circuit is 20volt and its internal resistance is 5Ω. There is a resistance box (in series with the battery and the potentiometer wire) whose resistance can be varied from 120Ω to 170Ω. Resistance of the potentiometer wire is 75Ω. The following potential differences can be measured using this potentiometer

(A) 5V (B) 6V (C) 7V (D) 8V

32. By mistake, a voltmeter is placed in series and an ammeter is parallel with a resistance in an electric circuit, with a cell in series.



(A) The main current in the circuit will be very low and almost all current will flow through the ammeter, if resistance of ammeter is much smaller than the resistance in parallel.

(B) If the devices are ideal, a large current will flow through the ammeter and it will be damaged

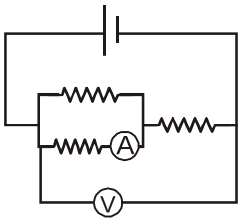
(C) If the devices are ideal, ammeter will read zero current and voltmeter will read the emf of cell

(D) The devices may get damaged if emf of the cell is very high and the meters are nonideal.

33. A galvanometer together with an unknown resistance in series is connected across two identical batteries each of 1.5 V. When the batteries are connected in series, the galvanometer records a current of 1A, and when the batteries are in parallel the current is 0.6 A. What is the internal resistance of the battery?

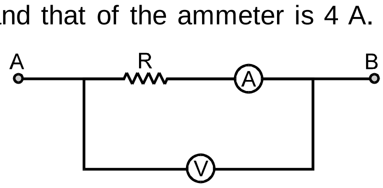
(A) $r = \frac{2}{3}\Omega$ (B) $r = \frac{2}{5}\Omega$ (C) $r = \frac{1}{3}\Omega$ (D) $r = \frac{3}{2}\Omega$

34. In the figure shown, all the resistors have the same resistance. If the ideal ammeter reads 2 A and the ideal voltmeter reads 15 V, what is the resistance of each resistor?



(A) $\frac{5}{2}$ ohm (B) $\frac{15}{4}$ ohm (C) $\frac{15}{2}$ ohm (D) $\frac{5}{3}$ ohm

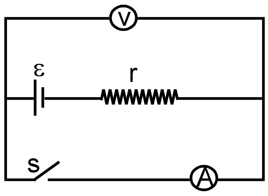
35. A non-ideal voltmeter and a non-ideal ammeter are connected as shown in the figure. The reading of the voltmeter is 20 V and that of the ammeter is 4 A. The value of R is :



(A) 5 Ω (B) less than 5 Ω

(C) greater than 5 Ω (D) may be less than 5 Ω

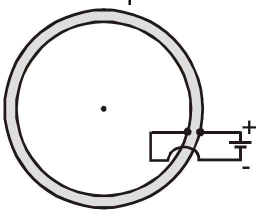
36. In the given figure a battery of emf ε and internal resistance r connected to measure r. The resistance voltmeter is much higher and the resistance of ammeter negligible . When switch is open voltmeter reads 1.52 V and when as closed reading the voltmeter is reduced by 1.45V and ammeter reduced by 1.0A. Find the emf and the internal resistance of the battery ?



37. (a) The current density across a cylindrical conductor of radius R varies according to the equation $J = J_0\left(1 - \frac{r}{R}\right)$, where r = distance from the axis. Thus the current density is a maximum J_0 at the axis r = 0 and decreases linearly to zero at the surface r = R. Calculate the current in terms of J_0 and the conductor's cross-sectional area $A = \pi R^2$.

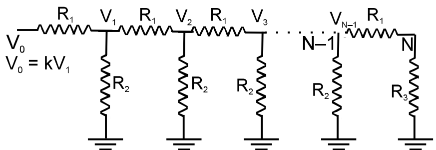
(b) Suppose that instead the current density is a maximum J_0 at the surface and decreases linearly to zero at the axis so that $J = J_0\frac{r}{R}$. Calculate the current.

38. A spherical shell, made of material of electrical conductivity $\frac{10^9}{\pi}(\Omega\text{-m})^{-1}$, has thickness t = 2 mm and radius R = 10 cm. In an arrangement, its inside surface is kept at a lower potential than its outside surface.



Find The resistance offered by the shell.

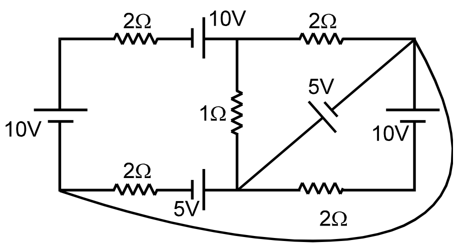
39. A network of resistance is constructed with R_1 and R_2 as shown in the figure. The potential at the points 1, 2, 3,........, N are V_1, V_2, V_3,.........., V_n respectively each having a potential K time smaller than previous one. Find:



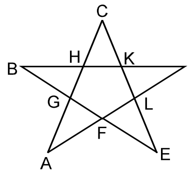
(i) $\frac{R_1}{R_2}$ and $\frac{R_2}{R_3}$ in terms of K.

(ii) Current that passes through the resistance R_2 nearest to the V_0 in terms V_0, K and R_3.

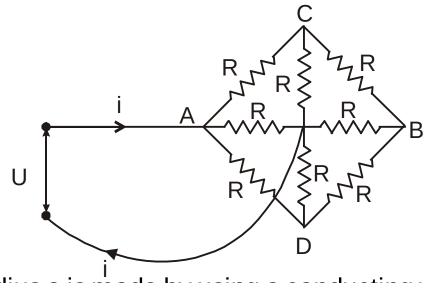
40. In the circuit diagram shown find the current through the 1 Ω resistor.



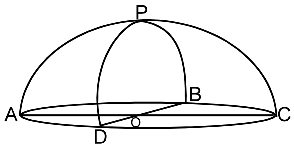
41. The figure is made of a uniform wire and represents a regular five pointed star. The resistance of a section EL is 2 ohm. Find the resistance of the star across F and C. (sin 18º ~ $\frac{1}{3}$)



42. The resistance of each resistor in the circuit diagram shown in figure is the same and equal to R. The voltage across the terminals is U. Determine the current I in the leads if their resistance can be neglected.



43. A hemispherical network of radius a is made by using a conducting wire of resistance per unit length 'r'. Find the equivalent resistance across OP.

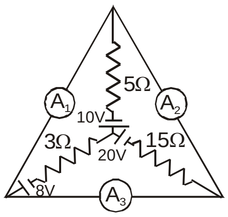


44. A rod of length L and cross-section area A lies along the x-axis between x = 0 and x = L. The material obeys Ohm's law and its resistivity varies along the rod according to, $\rho(x) = \rho_0 e^{-x/L}$
The end of the rod at x = 0 is at a potential V_0 and it is zero at x = L
(a) Find the total resistance of the rod and the current in the wire.
(b) Find the electric potential V(x) in the rod as a function of x.

45. The region between two concentric conducting spheres of radii r_a and r_b is filled with a conducting material of resistivity ρ

(a) Show that the resistance between the spheres is given by, $R = \frac{\rho}{4\pi}\left(\frac{1}{r_a} - \frac{1}{r_b}\right)$.
(b) Derive an expression for the current density as a function of radius, if the potential difference between the spheres is V_{ab}.
(c) Find the electric field at distance 'r' from the centre in part (b)

46. In the given circuit the ammeter A_1 and A_2 are ideal and the ammeter A_3 has a resistance of $1.9 \times 10^{-3}\ \Omega$. Find the readings of all three meters.



47. A voltmeter of resistance R_V and an ammeter of resistance R_A are connected in series across a battery of emf E and of negligible internal resistance. When a resistance R is connected in parallel to voltmeter, reading of ammeter increases to three times while that of voltmeter reduces to one third. Calculate R_A and R_V is terms of R.

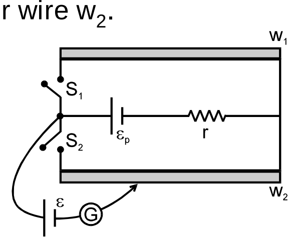
48. In a potentiometer circuit, two wires of same material of resistivity ρ, one of radius of cross-section 'a' and other of radius of cross-section '2a' are joined in series. They are of length ℓ and 2ℓ respectively. This combination acts as the potentiometer wire of length 3ℓ. The emf of the cell in the primary circuit is ε and internal resistance is $\frac{\rho\ell}{2\pi a^2}$. This cell is connected to the potentiometer wire by a conducting wire of negligible resistance with positive terminal of the cell connected to one end (call it A) of longer wire. The negative terminal of the cell is connected to one and of the smaller wire. The remaining ends of the two wires are joined together. Find:

(i) The maximum voltage which can be balanced on the potentiometer wire.

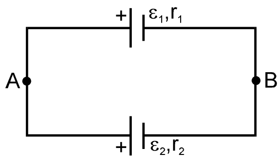
(ii) The balancing length, measured from point A, obtained in measurement of emf of cell of emf $\frac{\varepsilon}{2}$.

(iii) If positive terminal of cell of emf $\frac{\varepsilon}{2}$ and internal resistance $\frac{\rho\ell}{2\pi a^2}$ is connected to point A and other terminal is joined to the junction of the two wires, then find the current through this cell

49. Two potentiometer wires w_1 and w_2 of equal length ℓ connected to a battery of emf ε_P and internal resistance ' r ' through two switches s_1 and s_2. A battery of emf ε is balanced on these potentiometer wires. If potentiometer wire w_1 is of resistance 2r and balancing length is $\ell/2$ when only s_1 is closed and s_2 is open. On closing s_2 and opening s_1 the balancing length on w_2 is found to be $\left(\frac{2\ell}{3}\right)$, then find the resistance of potentiometer wire w_2.



50. Two cells of unequal emfs ε_1 and ε_2, and internal resistances r_1 and r_2 are joined as shown. V_A and V_B are the potentials at A and B respectively.



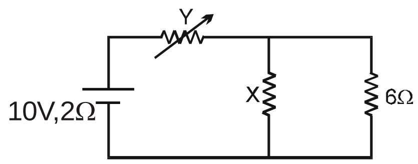
(A) One cell will continuously supply energy to the other

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

(C) The potential difference across one cell will be greater than its emf.

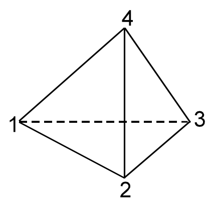
(D) $V_A - V_B = \frac{(\varepsilon_1 r_2 + \varepsilon_2 r_1)}{r_1 + r_2}$

51. In the figure shown the thermal power generated in ' y ' is maximum when y = 4 Ω. Then X is:



(A) 2 Ω (B) 3 Ω (C) 1 Ω (D) 6 Ω

52. A wire is in the form of a tetrahedron. The resistance of each edge is r. The equivalent resistances between corners 1–2 and 1–3 are respectively



(A) $\frac{r}{2}, \frac{r}{2}$ (B) r, r (C) $\frac{r}{2}$, r (D) r, $\frac{r}{2}$

53. N cells each of e.m.f. E & identical resistance r are grouped into sets of K cells connected in series. The (N/K) sets are connected in parallel to a load of resistance R, then;

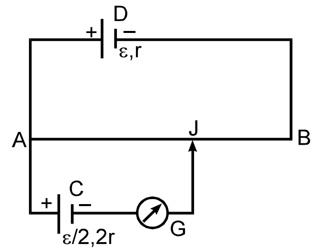
(A) Maximum power is delivered to the load if $K = \sqrt{\frac{NR}{r}}$.

(B) Maximum power is delivered to the load if $K = \sqrt{\frac{r}{NR}}$

(C) Maximum power delivered to the load is $\frac{NE^2}{4r}$

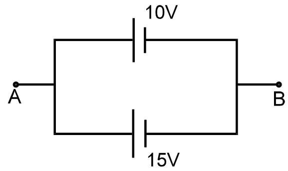
(D) Maximum power delivered to the load is $\frac{E^2}{4Nr}$

54. In the fig. the potentiometer wire AB of length L & resistance 9 r is joined to the cell D of e.m.f. ε & internal resistance r. The cell C's e.m.f. is $\varepsilon/2$ and its internal resistance is 2 r.
The galvanometer G will show no deflection when the length AJ is:



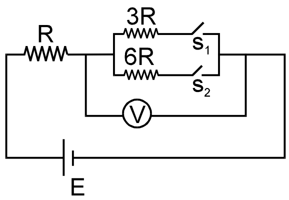
(A) 4L/9 (B) 5L/9 (C) 7L/18 (D) 11L/18

55. Two cells of e.m.f. 10 V & 15 V are connected in parallel to each other between points A & B. The cell of e.m.f. 10 V is ideal but the cell of e.m.f. 15 V has internal resistance 1 Ω. The equivalent e.m.f. between A and B is:



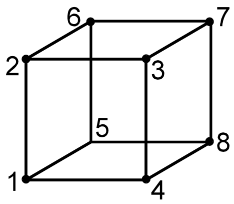
(A) $\frac{25}{2}$ V (B) not defined (C) 15 V (D) 10 V

56. 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 and reading of voltmeter is V_3 when both S_1 and S_2 are closed. Then



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

57. Find the resistance of a wire frame shaped as a cube (figure) when measured between points 1-7

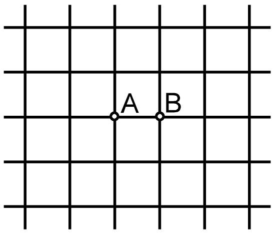


(A) $\frac{5}{3}R$ (B) $\frac{5}{6}R$ (C) $\frac{3}{5}R$ (D) $\frac{6}{5}R$

58. In the previous question find the resistance between points 1 - 3.

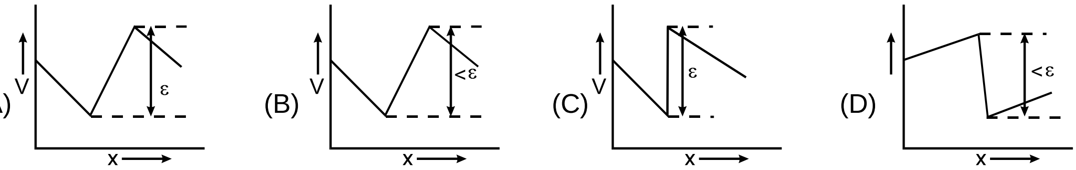
(A) $\frac{3}{4}R$ (B) $\frac{5}{6}R$ (C) $\frac{3}{5}R$ (D) $\frac{6}{5}R$

59. There is an infinite wire grid with square cells (figure). The resistance of each wire between neighbouring joint connections is equal to R_0. Find the resistance R of the whole grid between points A and B.

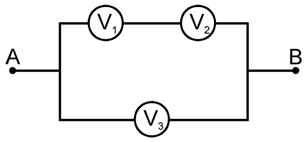


(A) R_0 (B) $R_0/2$ (C) $R_0/4$ (D) $R_0/8$

60. The two ends of a uniform conductor are joined to a cell of emf ε and some internal resistance. Starting from the midpoint P of the conductor, we move in the direction of the current and return to P. The potential V at every point on the path is plotted against the distance covered (*x*). Which of the following best represents the resulting curve?



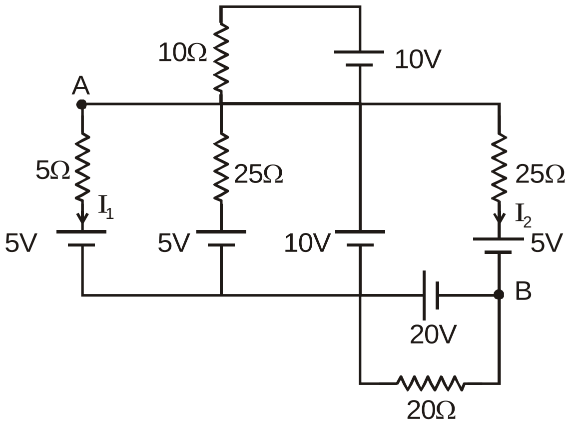
61. Three voltmeters, all having different resistances, are joined as shown. When some potential difference is applied across A and B, their readings are V_1, V_2, V_3 :



(A) $V_1 = V_2$ (B) $V_1 \neq V_2$ (C) $V_1 + V_2 = V_3$ (D) $V_1 + V_2 > V_3$

Paragraph for Question Nos. 62 to 64.

The circuit consists of resistors and ideal cells. I_1 and I_2 are current through branches indicated in the figure. V_A and V_B is the potential at points A and B on the circuit.



62. The value of $\frac{I_2}{I_1}$ is :

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

63. The value of $V_A - V_B$ in volts is :

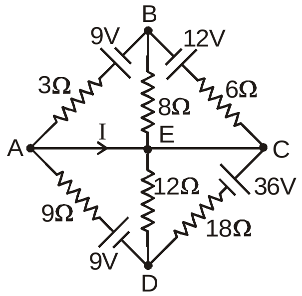
(A) 5 (B) 10 (C) 15 (D)30

64. The net power dissipated in the circuit in watts is :

(A) 55 (B) 15 (C) 62 (D) 61

Paragraph for Question Nos. 65 to67

In the shown circuit all cells are ideal.



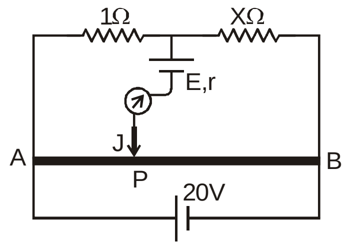
65. The magnitude of current through 8Ω resistor connected between points B and E is equal to :
(A) 0.25 A (B) 0.5 A (C) 1 A (D) 2 A

66. The magnitude of current I through conducting wire connected between A and E is equal to :

(A) $\frac{1}{3}$ A (B) 1 A (C) $\frac{4}{3}$ A (D) Zero

67. Let potential at points B and D be V_B and V_D respectively. Then $V_B - V_D$ is equal to :
(A) 4V (B) – 4V (C) 20 V (D) – 20 V

Paragraph for Question Nos. 68. to 70



AB is a uniform wire of meter bridge, across which an ideal 20 volt cell is connected as shown. Two resistor of 1 Ω and X Ω are inserted in slots of metre bridge. A cell of emf E volts and internal resistance r Ω and a galvanometer is connected to jockey J as shown.

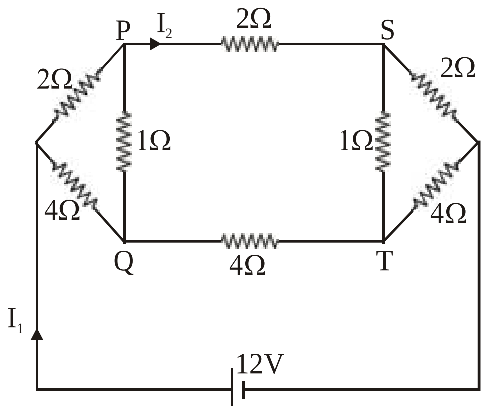
68. If E = 16 volts, r = 4 Ω and distance of balance point P from end A is 90 cm, then the value of X is :

(A) 3 Ω (B) 6 Ω (C) 9 Ω (D) 12 Ω

69. If E = 16 volts, r = 8 Ω and X = 9 Ω, then the distance of balance point P from end A is :
(A) 10 cm (B) 30 cm (C) 60 cm (D) 90 cm

70. If E = 12 volts, X = 9 Ω, then distance of balance point P from end A is
(A) 20 cm (B) 50 cm (C) 70 cm (D) Data insufficient

71. For the resistance network shown in the figure, choose the correct option(s).



(A) The current through PQ is zero (B) I_1 =3A
(C) The potential at S is less than that at Q. (D) I_2 =2A

Answers Key

1. $\frac{1.5\times 63.5\times 10^{-3}}{1.6\times 6\times 9}$ = 1.1 × 10^{-3} ms^{-1} or 1.1 mm s^{-1} 2 **2.** 7.5 × 10^{-9} N 3. (c) 4. (d)

5. (a) 6. (d) 7. (a) 8. (b) 9. **(i)** 41ºC **(ii)** $\frac{\ell n2}{273}$ $^{o}C^{-1}$.

10. $T_2 > T_1$

11. (a) E = 10 V each (b) (A) act as a source and (B) act as load (c) V_A = 9V, V_B = 11 V
(d) P_A = 9 W, P_B = 11 W (e) Heat rate = 1 W each (f) 10 watt. each (g) 9V, 11V (h) -9W, 11 W

12. (a) 7.5 V, (b) 24 mA (c) greater than 12 V.

13. (b) 14. (d) 15. (a,c) 16. (a,b,d) 17. (b) 18. (c) 19. (a)

20. (a) 3.7 V (b) 3.7 V 21. (i) $\frac{150}{7}$ = 21.43 V, (ii) 1600 Ω

22. Consider a thin shell of radius r, thickness dr. $i = \frac{dv}{R} = \frac{Edr}{\frac{\rho dr}{4\pi r^2}} = \frac{E4\pi r^2}{\rho} = \frac{\phi}{\rho}$.

23. (a) 24. (a) 25. (c) 26. (25) 27. (a) 28. (a) 24 V,(b) 28V

29. $\left(\frac{70}{60}-1\right)\times 9.5 = \frac{9.5}{6}$ ohm

30. (a) $\frac{82.3}{67.3}\times 1.02 = 1.25$ V

(b) The high resistance to keep the initial current low when null point is being located. This saves the standard cell from damage.

(c) This high resistance does not affect the balance point because then there is no flow of current through the standard cell branch.

(d) The internal resistance of driver cell affects the current through the potentiometer wire. Since potential gradient is changed, therefore, the balance point must be affected.

(e) No. It is necessary that the emf of the driver cell is more than the emf of the cells.

(f) This circuit will not work well for meaurement of small emf. (mV) because the balanced point will be very near to end A, and percentage error in EMF measured due to length measument would be very large $E = \frac{V}{100}\ell \Rightarrow \frac{dE}{E} = \frac{d\ell}{\ell}$ will be large if ℓ is very small.

31. (a,b,c) 32. (a,c,d) 33. (b) 34. (b) 35. (b) 36. 1.52 V, 0.07 W

37. (a) $J_0A/3$ (b) $2J_0A/3$ 38. 5 x 10^{-11} Ω

39. (i) $\frac{(K-1)^2}{K}$; $\frac{K}{(K-1)}$ (ii) $\left[\frac{(K-1)}{K^2}\right]\frac{V_0}{R_3}$

40. $i = \frac{5/2}{1} = \frac{5}{2}$ *amp. Ans.* *41.* 2 Ω 42. $i = \frac{15}{7}\frac{U}{R}$ 43. $\frac{(2+\pi)ar}{8}$

44. (a) $R = \rho_0\frac{L}{A}\left(\frac{e-1}{e}\right)$, $i = \frac{V_0}{R}$, (b) $V(x) = \frac{V_0(e^{-x/L}-e^{-1})}{1-e^{-1}}$

45. (b) $\left[\frac{V_{ab}r_ar_b}{\rho r^2(r_b - r_a)}\right]$ (c) $\left[\frac{V_{ab}r_ar_b}{r^2(r_b - r_a)}\right]$ 46. $I_1 = 82/27$, $I_2 = 34/27$, $I_3 = 0$ 47. $R_A = \frac{8}{3}R, R_V = 8R$

48. (i) $v_0 = \frac{3\varepsilon}{4}$ (ii) $\frac{5\ell}{2}$ (iii) $\frac{\varepsilon}{7R}$, where $R = \frac{\rho\ell}{A}$ and $A = 2\pi a^2$

49. R = r.

50.	(a,b,c,d)			51.	(b)	52.	(a)	53.	(a,c,d)	54.	(b)	55.	(d)
56.	(b)	57.	(a)	58.	(a)	59.	(b)	60.	(b)	61.	(b,c)		
62.	(a)	63.	(d)	64.	(d)	65.	(c)	66.	(d)	67.	(a)		
68.	(a)	69.	(d)	70.	(c)	71.	(a,b,c,d)						