Electric current

Multiple choice -

1. For which of the following dependence of drift velocity υ on electric field E is ohm's law obeyed?
   (a) $\upsilon \propto E$ (b) υ = constant (c) $\upsilon \propto E^{1/2}$ (d) $\upsilon \propto E^2$

   Ans-a

2. in metals the time of relaxation of electrons:
   (a) increases with increasing temperature
   (b) decreases with increasing temperature
   (c) does not depend on temperature
   (d) changes suddenly at 400 K
   Ans-b
3. Constantan wire is used for making standard resistance because it has:
   (a) low specific resistance
   (b) high specific resistance
   (c) negligible temperature coefficient of resistance
   (d) high melting point
   Ans-c
4. A potential difference is applied across the ends of a metallic wire. If the potential difference is doubled, the drift velocity:
   (a) will be doubled (c) will be quadrupled
   (b) will be halved (d) will remain unchanged
   Ans-a
5. The maximum current that flows in the fuse wire, before it blow out, varies with the radius r as:
   (a) $r^{3/2}$ (b) r (c) $r^{2/3}$ (d) $r^{1/2}$

   Ans-a

6. A wire of resistance R is cut into n equal parts. These parts are then connected in parallel. The equivalent resistance of the combination will be:
   (a) nR (b) R/n (c) n/R (d) R/n^2

   Ans-d

7. The masses of three wires of copper are in the ratio of 1 : 3 : 5 and their lengths are in the ratio 5 : 3 : 1. The ratio of their electrical resistances is:
   (a) 1 : 3 : 5 (b) 5 : 3 : 1 (c) 1 : 15 : 125 (d) 125 : 15 : 1
   Ans-d
8. Kirchhoff's first law is based on the law of conservation of:

(a) charge (b) energy (c) momentum (d) sum of mass and energy

Ans-a

9. Kirchhoff's second law is based on the law of conservation of:

(a) charge (b) energy (c) momentum (d) sum of mass and energy

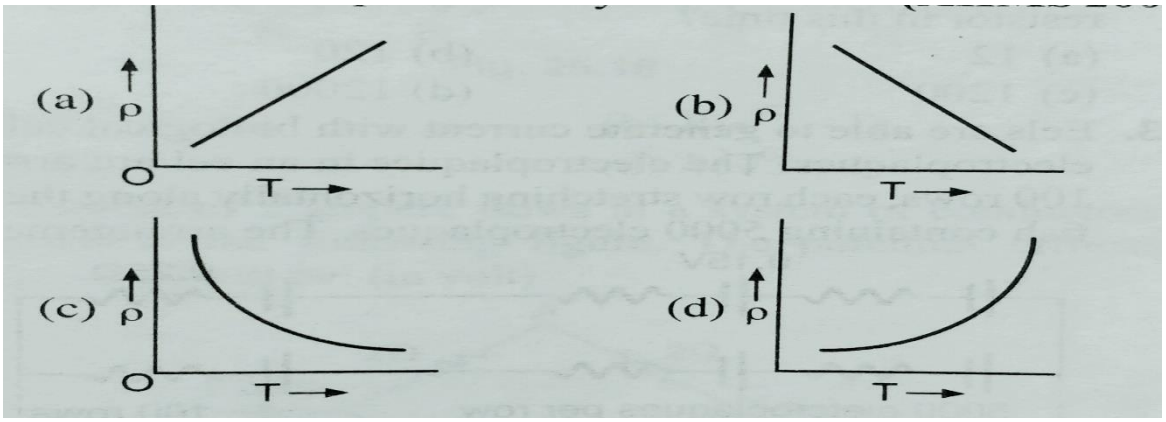
Ans-b

10. A call of emf E is connected across a resistance r. The potential difference between the terminal of the cell is found to be V. The internal resistance of the cell must be:

(a) 2(E – V)V/r (b) 2(E – V)r/E (c) (E – V)r/V (d) (E – V)r

Ans-c

11. The temperature (T) dependence of resistivity (ρ) of a semiconductor is represented by:



Ans-b

12. A wire of resistance R is stretched till its radius is half of the original value. Then, the resistance of the stretched wire is:

(a) 2R (b)4R (c)8R (d)16R

Ans-d

13. A wire of resistance R is stretched till is length is double of the original wire.

Then the, resistance of the stretched wire is:

(a)2R (b)4R (c)8R (d)16R

Ans-b

14. If a copper wire is stretched to make it 0.1% longer, then the percentage

Change in resistance is approximately:

(a)0.1% (b)0.2% (c)0.4% (d)0.8%

Ans-b

15. If a copper wire is stretched to make it radius decrease by 0.1% ,then the

Percentage in increase in resistance is approximately:

(a)0.1% (b)0.2% (c)0.4% (d)0.8%

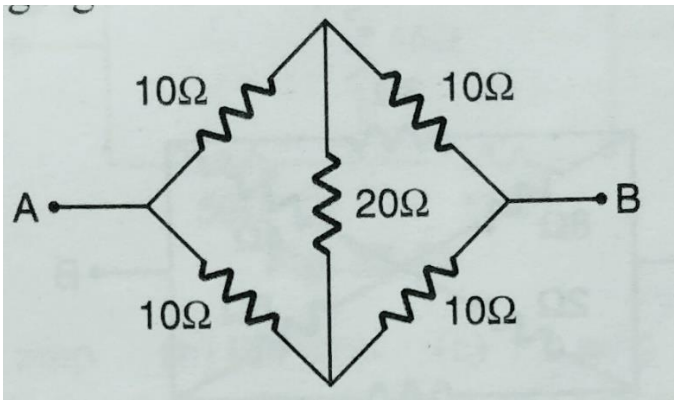
Ans-c

16. A cell of emf E and internal resistance r is connected in series with an external resistance nr . the, the ratio of the terminal potential difference to emf is:

(a) (1/n) (b) 1/(n+1) (c)n/(n+1) (d) (n+1)/n

Ans-c

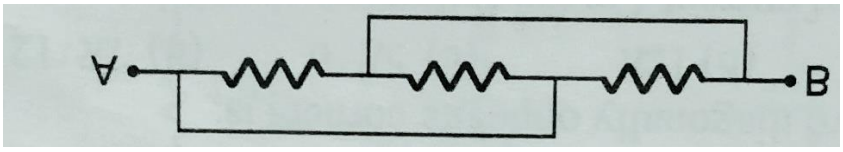
17. The equivalent resistance between the points A and B in the following figure is:



(a) 10Ω (b) 20Ω (c) 40Ω (d) 5Ω

Ans-a

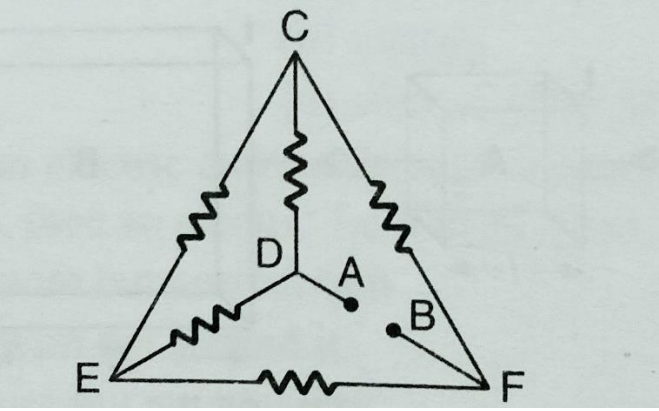
18. Three equal resistors, each equal to R, are connected as shown in the following figure, then the equivalent resistance between points A and B is:



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

Ans-c

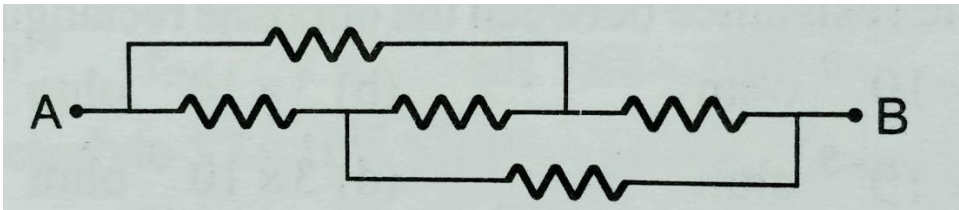
19. In the given network of resistors, each of resistance R ohm, the equivalent resistance between points A and B is:



(a) 5R (b) 2R/3 (c) R (d) R/2

Ans-c

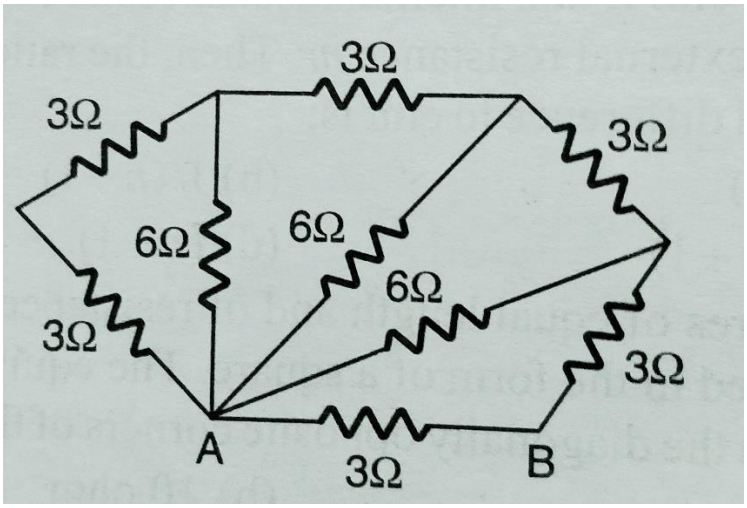
20. Five equal resistors, each equal to R, are connected as shown in the following figure; then the equivalent resistance between points A and B is:



(a) R (b) 5R (c) R/5 (d) 2R/3

Ans-a

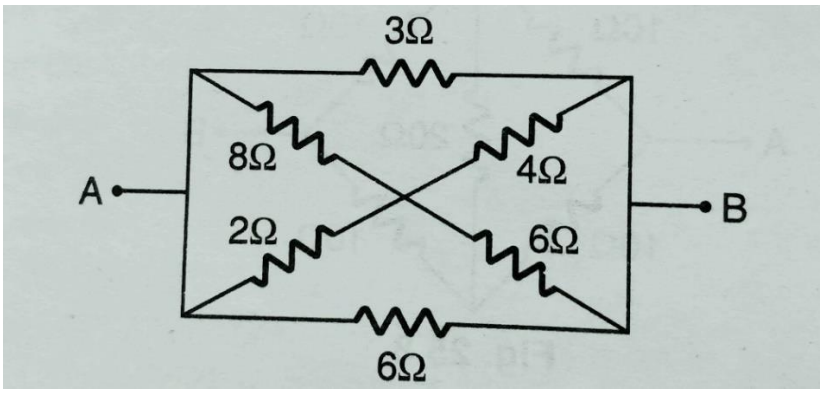
21. The resistances in the following figure are in ohm. Then, the effective resistance between the points A and B is:



(a) 3Ω (b) 2Ω (c) 6 (d) 36Ω

Ans-b

22. In the following figure, the equivalent resistance between A and B is : (figure



(a) (17/24)Ω (b) (4/3)Ω (c) 29Ω (d) (24/17)Ω

Ans-b

23. Two wires of same metal have same length but their cross-sections are in the ratio 3 : 1. They are joined in the series. The resistance of the thicker wire is 10Ω. The total resistance of the combination will be:

(a) (5/2) Ω (b) (40/3) Ω (c) 40 Ω (d) 100 Ω

Ans-c

24. The tolerance level of a resistor with the colour code red, blue, orange, gold is:

(a) ± 5% (b) ± 10% (c) ± 20% (d) ± 40% (e) ± 30%

Ans-a

25. Two cells of emfs E_1 and E_2 and internal resistances r_1 and r_2 are connected in parallel. Then, the emf and internal resistance of the equivalent source is:

(a) $E_1 + E_2$ and $r_1r_2/r_1 + r_2$

(b) $E_1 – E_2$ and $r_1 + r_2$

(c) $E_1r_2 + E_2r_1/r_1 + r_2$ and $r_1r_2/r_1 + r_2$

(d) $E_1r_2 + E_2r_2/r_1 r_2$ and $r_1 + r_2$

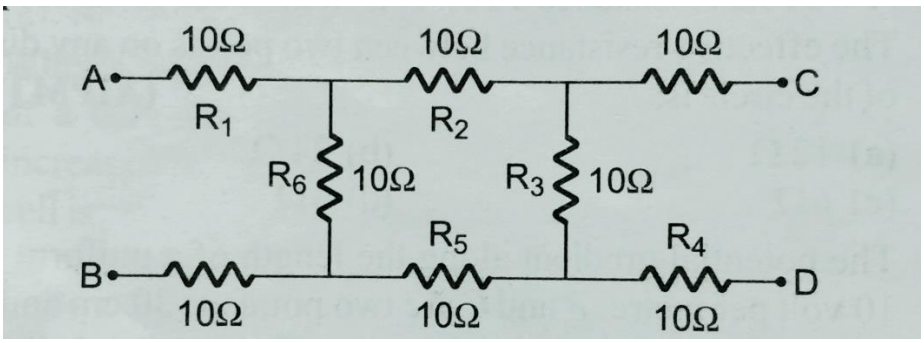
Ans-c

26. A wire has resistance 12Ω. It is bent in the from of a circle. The effective resistance between two points on any dimeter of the circle is:

(a) 12 Ω (b) 24 Ω (c) 6 Ω (d) 3 Ω

Ans-d

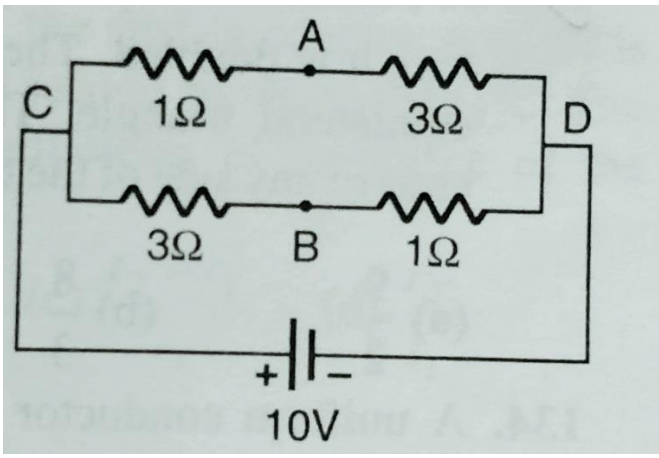
27. What will be the equivalent resistance between the two points A and D?



(a) 10 Ω (b) 20 Ω (c) 30 Ω (d) 40 Ω

Ans-c

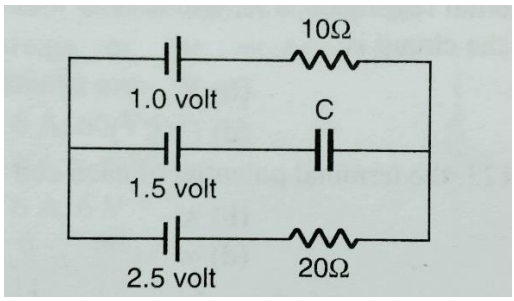
28. A battery of emf 10 V is connected to resistance as shown in the figure. The potential difference between A and B, (V_A -V_B) is:



(a) -2V (b) 2V (c) 5V (d) (20/11)V

Ans-c

29. In the following circuit diagram the potential difference across the plates of the capacitor C is:



(a) 2.5 volt (b) 1.5 volt (c) 1.0 volt (d) zero

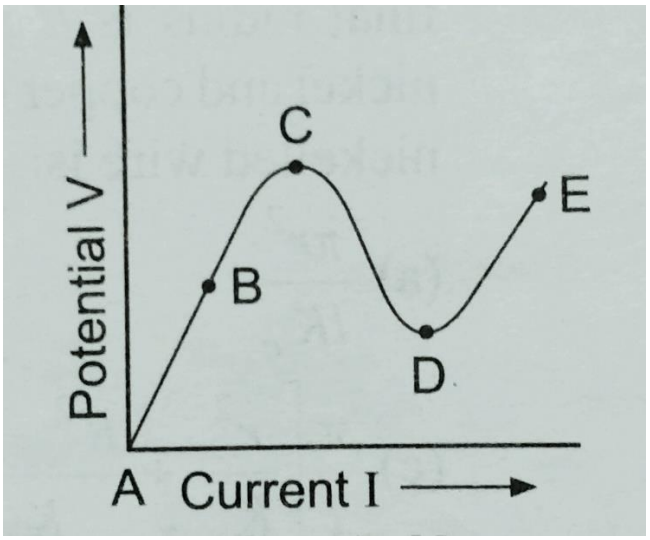
Ans-d

30. n cells of emfs E_1, E_2, E_3, ….., E_n and internal resistance r1, r2, r3,……, rn are connected in series to from a closed circuit with zero external resistance. For each cell the ratio of emf to internal resistance is K, where K is a constant; then current in the circuit is:

(a) (1/K) (b) K (c) K^2 (d) $(1/K^2)$

Ans-b

31. Which part represents the negative dynamic resistance?



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

Ans-c

32. A conductor of resistance 3Ω is stretched uniformly till its length is doubled. The wire is now bent in the form of an equilateral triangle. The effective resistance between the ends of any side of the triangle (in ohm) is:

(a) 9/2 (b) 8/3 (c) 2 (d) 1

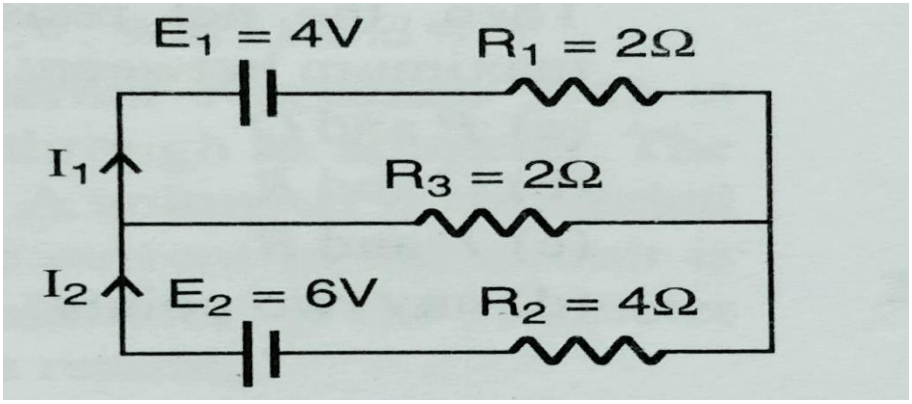
Ans-b

33. The sides of a rectangular block are 2cm, 3cm and 4cm. The ratio of maximum to minimum resistance between its parallel faces is:

(a) 4 (b) 3 (c) 2 (d) 1

Ans-a

34. In the circuit shown:



$E = 4.0V$, $R_1 = 2\Omega$,

$E_2 = 6.0V$, $R_2 = 4\Omega$

and $R_3 = 2\Omega$. The current I_1 is:

(a) 1.6 A

(b) 1.8 A

(c) 1.25 A

(d) 1.0 A

Ans-b

35. n cells each of emf E and internal resistance r send the same current through an external resistance R whether the cells are connected in series or in parallel. Then:

(a) R = nr (b) R = r (c) r = nR (d) R = √nr (e) r = √nR

Ans-b

36. In a meter bridge with standard resistance of 5Ω in the left gap, the ratio of balancing lengths of meter bridge wire is 2 : 3. The unknown resistance is:

(a) 1 Ω (b) 15 Ω (c) 10 Ω (d) 33 Ω (e) 7.5 Ω

Ans-e

37. The electric resistance of a certain wire of iron is R. If its length and radius are both doubled, then:

(a) the resistance will be doubled and the specific resistance will be halved

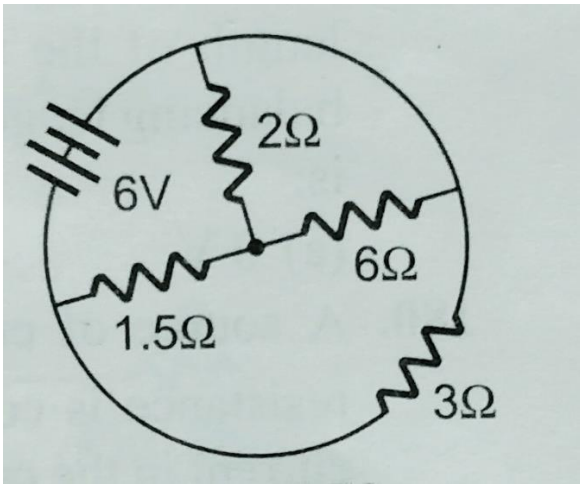
(b) the resistance will be halved and the specific resistance will remain unchanged

(c) the resistance will be halved and the specific resistance will be doubled

(d) the resistance and the specific resistance will both remain unchanged

Ans-b

38. The total current supplied to the circuit by the battery is:



(a) 1 A

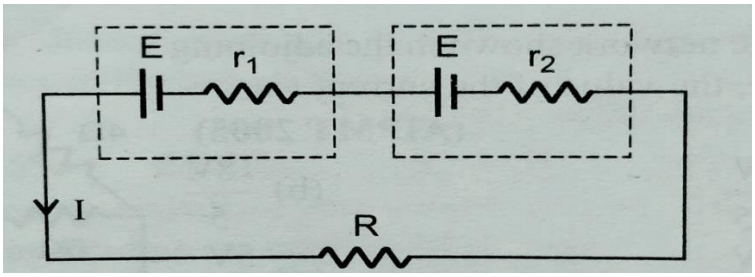
(b) 2 A

(c) 4 A

(d) 6 A

Ans-c

39. If the potential difference across the internal resistance r_1 is equal to the emf E of the battery, then:



(a) $R = r_1 + r_2$ (b) $R = r_1/r_2$ (c) $R = r_1 - r_2$ (d) $R = r_2/r_1$

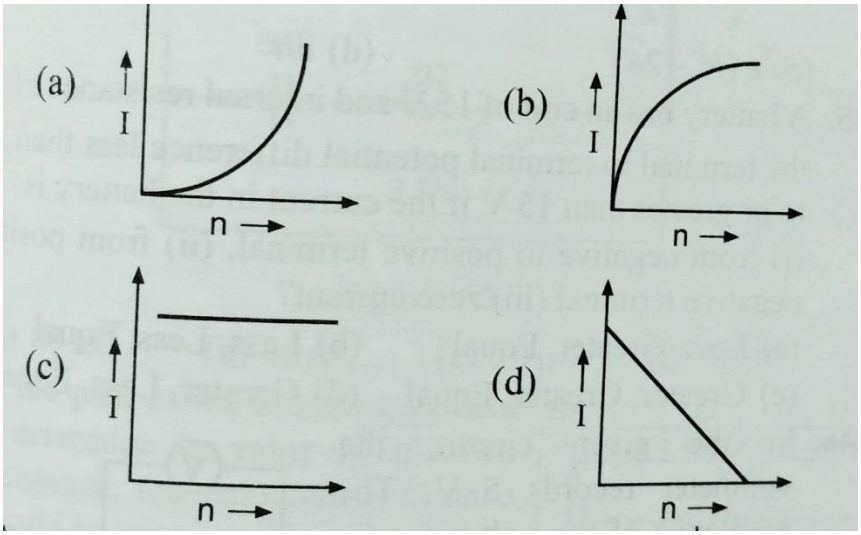
Ans-c

40. Potentiometer wire of length 1 m is connected in series with 490 Ω resistance and 2 V battery. If 0.2 mV/cm is the potential gradient, then resistance of the potentiometer wire is:

(a) 4.9 Ω (b) 7.9 Ω (c) 5.9 Ω (d) 6.9 Ω

Ans-a

41. A battery consists of a variable number (n) of identical cells, each having an internal resistance r connected in series. The terminals of the battery are short-circuited. A graph of current (I) in the circuit versus the number of cells will be as shown in the following figure:



Ans- c

42. Two copper wires of length l and 2l have radii, r and 2r respectively. What is the ratio of their specific resistances?

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

Ans-c

43. Two wires have lengths, diameters and specific resistance all in the ratio of 1 : 2. The resistance of the first wire is 10 ohm. Resistance of the second wire (in ohm) will be:

(a) 5 (b) 10 (c) 20 (d) infinite

Ans-b

44. A carbon resistor is marked with the rings coloured brown, black, green and gold. The resistance (in ohm) is:

(a) $3.2 \times 10^5 \pm 5\%$

(b) $1 \times 10^6 \pm 10\%$

(c) $1 \times 10^7 \pm 5\%$

(d) $1 \times 10^6 \pm 5\%$

(e) $1 \times 10^5 \pm 5\%$

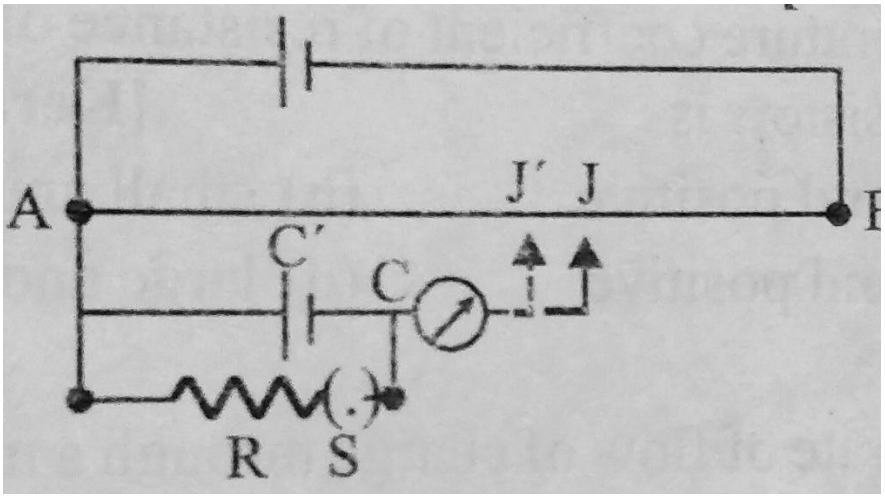
Ans-d

45. Two identical conductors maintained at different temperatures are given potential differences in the ratio 1 : 2. Then, the ratio of their drift velocities is:

(a) 1 : 2 (b) 3 : 2 (c) 1 : 1 (d) 1 : $2^{1/2}$ (e) 1 : 4

Ans- b

46. In the potentiometer circuit shown in the figure, the balance length AJ = 60 cm when switch S is open. When switch S is closed and the value of R = 5Ω, the balance length AJ' = 50 cm. The internal resistance of the cell C' is:



(a) 1.2 Ω (b) 1.0 Ω (c) 0.8 Ω (d) 0.6 Ω

Ans -(b),

47. A potentiometer wire is 100cm long and a constant potential difference is maintained across it. Two cells are connected in series first to support one another and then in opposite direction. The balance points end of the wire in the two cases. The ratio of emf's is:

(a) 5 : 1 (b) 5 : 4 (c) 3 : 4 (d) 3 : 2

Ans- (d),

Fill in the blanks

1. Kirchhoff's I law for electric network is based on_____.

Ans. Conservation of charge)

2. Kirchhoff's II law for electric network is based on_____.

Ans. Conservation of energy

3. A cell of emf E and resistance r is connected across an external resistance R. the potential difference acros the terminals of a cell for r = R is_____.

Ans. E/2

4. The alloys which are used for making resistances have very low Temperature coefficient of resistancea high_____.

Ans. Resistivity

5. Wheat Stone Bridge experiment is most sensitive when all the resistances are of _____.

Ans. Same Order

6. In slide wire bridge experiment, copper strips are used in place of copper wires, due to their low___.

Ans. Conductivity

7. EMF so two cells can be compared using_____apparatus

Ans. Potentiometer

8. Meter bridge works on the principle of_____.

Ans. Wheat Stone Bridge

9. As per Kirchhoff's II law, the algebraic sum of emfs is equal to algebraic sum of product of _____.

Ans. Current and Resistance

10. A battery of e.m.f. 2 volt and internal resistance 0.1 Ω is being charged with a current of 5 ampere. The p.d. between the two terminals of the battery is_____volt.

Ans. 2.5 volt ($V = E + Ir$ **,** $= 2 + 5 \times 0.1 = 2.5\ volt$ **)**

Very short answer type questions (1 marks)-

1. A wire of resistivity 'p' is stretched to twice its length .will be its new resistivity ?

2. What happens to the power dissipation, if the value of electric current passing through a resistance is halved ?

3. Two conductors , one having resistance R and another 2R, are connected in turn across a d.c. source .If the rate of heat produced in the two conductors is Q_1 and Q_2 Respectively, what is the value of of Q_1/Q_2 ?

4. How does the drift velocity of electrons in a metallic conductor very with increase in temperature ?

5.The metallic conductor is at a temperature θ_1.The temperature of the metallic conductor is increased to θ_2. How will the product of its resistivity and conductivity change ?

6. A uniform wire of resistance 20 Ω is cut into two equal parts. These parts are now connected in parallel then what will be the resistance of the combinations ?

7. A cell of e.m.f. 2 V and internal resistance 0.1 Ω is connected to a 3.9 Ω external resistance . What will be the p.d. across the terminals of the cell ?

8.Nichrome and copper wires of the same length and same radius are connected in series .Current I is passed through them .Why does the nichrome wire get heated first ?

9. Sate the condition in witch terminal voltage across a secondary cell is equal to its e.m.f.

10. Two bulbs whose resistances are in the ratio of 1 ; 2, are connected in parallel to a source of constant voltage . What will be the ratio of power dissipation in these?

11. A toaster produces more heat than a light bulb when connected in parallel to the 220 V mains. Which of the two has greater resistance ?

12. Why is a voltmeter always connected in parallel with a circuit element across which voltage is to be measured ?

13. If the length of a wire conductor is doubled by stretching it, keeping the p.d. across is constant, by what factor does the drift speed of electrons change ?

14. Define conductance of a material. Give its S.I. units.

15. Draw a graph showing the variation of resistivity with temperature for copper.

16. How does conductivity of a semiconductor increase with temperature?

17. A low voltage supply from which one needs high currents must have very low internal resistance Why ?

18. Write the mathematical relation between mobility and drift velocity of charge carriers in a conductor. Name the mobile charge carriers responsible for conduction of electric current in (1) an electrolyte ,and (2) an ionised gas.

19. Explain, how electron mobility changes for a good conductor when its temperature increases ?

20. Draw V-1 graph for ohmic and non-ohmic materials .Give one example for each.

22. Define the ‘temperature coefficient of resistivity’ .

23. Why is the terminal voltage of a cell less then its emf?

24. A wire of resistivity ρ is stretched to twice its length. What will be its new resistivity?

25. Define electrical conductivity of a metallic wire. Write its SI unit?

26. Show variation of resistivity of copper as a function of temperature in a graph?

27. How does drift velocity of electrons in a metallic conductor vary with increase in temperature? Give reason.

28. Why are alloys, manganin and constantan used to make standard resistance coils?

29. 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?

30. How does the random motion of free electrons in a conductor get affected when a potential difference is applied across its ends?

31. Define the term 'Mobility' of charge carriers in a conductor. Write its SI unit.

32. The three colored bands on a carbon resistor are red, green and yellow respectively. Write the value of its resistance.

33. What is the effect of interchanging the position of cell and galvanometer in a Wheatstone bridge?

34. Why are the connections between resistors in a meter bridge made of thick copper strips?

35. Why is it generally preferred to obtain balance point near the middle of bridge wire in meter bridge experiment?

36. Why is a potentiometer preferred over a voltmeter for measuring the emf of a cell?

37. A resistance R is connected across a cell of emf ε and internal resistance r. A potentiometer now measures the potential difference between the terminals of the cell as V. Write the expression for r in terms of ε, V and R.

38. What is the advantage of using thick metallic strips to join wires in a potentiometer?

Short answer type questions (2 marks)-

Q1. 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?

Q2. Two wires of equal length one of copper and other of the manganin have the same resistance which wire is thicker? Why?

Q3. A potential difference V is applied across a conductor of length L and diameter D. how are the electric field E and the resistance R of conductor affected when it turn (i) V is halved, (ii) L is halved and (iii) D is doubled ?

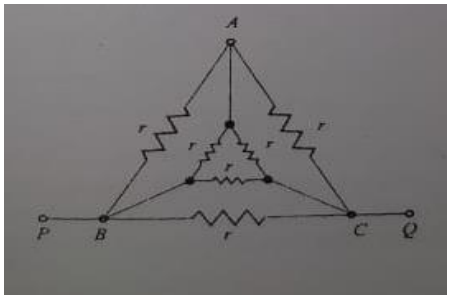
Q4. One metre long metallic wire is broken into two equal parts P and Q. the part P is uniformly extended into another wire R. The length of R is twice the length of P and resistance of R is equal to that of Q. Find the ration of the length P and Q.

Q5. A cell of emf E and internal resistance r is connected across a variable external resistor R. plot graphs to show variation of (i) E with R (ii) Terminal p.d of the cell V with R.

Q6. Name any one material having a small value of temperature coefficient of resistance. Write one use of this the material .

Q7. Why do we prefer a potentiometer to measure the emf of a cell rather then voltmeter ?

Q8. Find the equivalent resistance of the circuit shown in the following fig. between the points P and Q. Each resistor has a resistance r.



Q9. Define conductivity of a semiconductor. How conductivity of a metal changes with temperature?

Q10. Two cells of emf E_1 and E_2 and internal resistance r_1 and r_2 are connected in parallel with an external resistance R , find the equivalent resistance of the combination.

Long answer type questions (3 and 5 marks)

Q1.(a) A cell of emf E and internal resistance r is connected across a variable resistor R . Write the relation between emf , internal resistane and terminal potential .Also plot a graph showing variation of terminal voltage V of the cell versus the current I. Using the plot, show the emf of the cell and its internal resistance can be determined. (b)A potentiometer wire of length 1m has a resistance of 10Ω. Determine the emf of primary cell which gives a balance point at 40 cm .

Q2. Define drift velocity find expression for it , also find the relation between drift velocity and current . Using these expression also derive Ohm,s law .

Q3. How the resistivity of a conductor , semiconductor and alloy changes with temperature plot the graph . also explain the term temperature coefficient of resistance or resistivity.

Q4. Explain Wheat-Stone- Bridge , find its balancing condition. Also explain the meter-bridge . what material of wire is used in meter- bridge and why ?

Q7. Draw the circuit diagram of a potentiometer which can be used to determine the internal resistance r of a given cell of emf E. Explain briefly how the internal resistance of the cell is determined?

Q8. (i) State the principle of working of a potentiometer . How a potentiometer is used to (a) to find the emf of the cell(b) To compare the emf of the cell(c)To find the internal resistance of the cell ? Using proper circuit diagram. (ii) (a)what is the purpose of using the high resistance with the Galvenometer? (b) How does the position of balance point (J) change when the resistance connected in series with the wire and driver cell is decreased ? (c) why can not the balance point be obtained , when the emf of primary cell is greater than emf of driver cell . (iii) write two possible causes for one sided deflection in a potentiometer experiment. (iv)Which material is used for potentiometer wire and why? (v)how can the sensitivity of a potentiometer be increased?

Q9. Answer the following ; (i) Why are the connections between the resistor in a meter bridge made of thick copper strips? (ii)Why is it generally preferred to obtain the balance point in the middle of the meter bridge wire? (iii)which material is used for the meter bridge wire and why?

Q10. (i)State with the help of a circuit diagram, the working principle of a meter bridge. Obtain the expression used for determining the unknown resistance. (ii) what happens if the galvanometer and cell are interchanged at the balance point of the bridge? (iii) why is it considered important to obtain the balance point near the mid- point of the wire?

Q11. (a) A cell of emf E and internal resistance r is connected across a variable resistor R. Plot a graph showing the variation of terminal potential V with resistance R. (b) Plot a graph showing the variation of terminal potential difference across a cell of emf E and internal resistance r with current drawn from it. Using this graph how does one determine the emf of the cell?

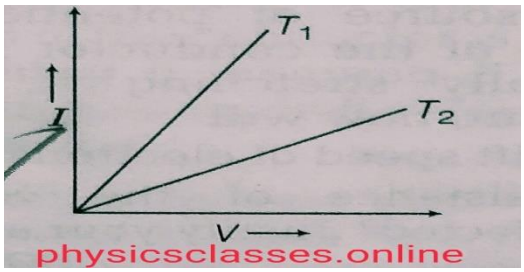
Q12. Two conducting wires X and Y of same diameter but different materials are joined in series across a battery. If the number of density of electrons in X is twice than that in Y, then find the ratio of drift velocity of electrons in the two wires.

Q13. (i)State Kirchhoff's rules for an electric network. (ii)Using Kirchhoff's rules, obtain the balance condition in terms of the resistance of four arms of whetstone bridge.

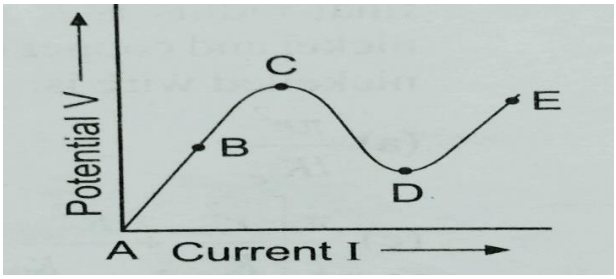
Q14. (i)State the principle of working of a meter bridge. (ii)In a meter bridge balance point is found at a distance l1 with resistances R and S in the two gap of the meter-bridge. When an unknown resistance X is connected in a parallel with the resistance S, the balance point shifts to a distance l2. Find expressions for X in terms of l1, l2 and S.

Q15. (i)Derive the relation between current density j and potential difference V across a current carrying conductor of length l, area of cross- section A and the number density n of free electrons. (ii) Estimate the average drift speed of conduction electron in a copper wire of cross- sectional area 1.0 x 10-7m2 carrying a current of 1.5A. [assume that the number density of conduction electron is 9 x 1028 m-3].

Q16. (i)I-V graph for a metallic wire at two different temperature T_1 and T_2 is as shown in the figure below. Which of the two temperature is lower and why?



(ii)Graph showing the variation of current versus voltage for a material GaAs is shown in the figure. Identify the region of (a)negative resistance. (ii) where Ohm's law is obeyed? (iii)Plot a graph showing variation of the current versus voltage for the material GaAs. (iv)Show variation of resistivity of copper as a function of temperature in graph.



Q17.A potential difference of V volts is applied to a conductor of length L, and diameter D. How will the drift velocity of electrons and the resistance of the conductor change when ;(i) V is doubled ,(ii) L is halved and (iii) D is halved .where ,in each case ,the other two factors remain same .Give reason in each case.

Numericals-

Q1. Two identical cell of emf 1.5 V each joined in a parallel provide supply to an external circuit consisting of two resistance of 17Ω each joined in a parallel. A very high resistance voltmeter reads the terminal voltage of cell to be 1.4V. Calculate the internal resistance of each cell.

Q2. Four identical cells, each of emf 2 V are joined in a parallel providing supply of current to external circuit consisting of 15Ω resistors joined in parallel. The terminal voltage of the cells, as read by an ideal voltmeter is 1.6 volt. Calculate the internal resistance of each cell.

Q3. Two cells E1 and E2 of emf 4V and 8V having internal resistance 0.5 Ω and 1.0 Ω respectively are connected in opposition to each other. The combination is connected in series with resistance of 4.5Ω and 3.0Ω. another resistance of 6.0Ω is connected in parallel across the 3Ω resistor.(a) Draw the circuit diagram (b)Calculate the total current flowing in circuit.

Q4. A cell of unknown emf E and internal resistance r, two unknown resistance R_1 and R_2 ($R_2 > R_1$) and a perfect ammeter are given. The current in the circuit is measured in five different situations (i) without any external resistance in the circuit, (ii) without any external resistance R_1 only (iii)with only resistance R_2 only (iv)With both R_1 and R_2 used in series combination and (v) With R_1 and R_2 used in parallel combination. The current obtained in the five cases are 0.42A, 0.6A, 1.05A, 1.4A and 4.2A, but not necessarily in the same order. Identify the currents in the five cases listed above and calculate E, r,R_1 and R_2. (E=4.2V, R_1=3 ohm, r= 1 ohm R_2=6 ohm)

Q5. Describe the formula for the equivalent EMF and internal resistance for the parallel combination of two cells with emf's E_1 and E_2 and internal resistance r1 and r2 respectively. What is the corresponding formula for the series combination? Two cells of emf 1V, 2V and internal resistance 2Ω and 1Ω respectively are connected in (i) series, (ii) parallel. What should be the external resistance in the circuit so that the current through the resistance be the same in the two cases? In which case more heat is generated in the cells?

Q7. the length of potentiometer wire is 600 cm and it carries a current of 40mA. For a cell of emf. 2V and internal resistance 10Ω the null point is found to be at 500m. If a voltmeter is connected across the cell, the balancing length is decreased by 10 cm. Find (i) The resistance of whole wire (ii) reading of voltmeter and (iii) resistance of voltmeter.

Q8. Two cells of emf's 1.5V and 2 V having internal resistance 2Ω and 1Ω respectively., have their negative terminals joined by a wire of 6Ω and +ve terminals by a wire of 4 Ω resistance A third resistance wire of 8 Ω connects middle points of these wires. Draw the circuit diagram. Using Kirchhoff's laws, find the potential difference at the end of this third wire.

Q9. A battery of emf 12.0 V and internal resistance 0.5Ω is to be charged by a battery charger which supplies 110 V d.c. How much resistance must be connected in series with the battery to limit the charging current to 5.0 A? What will be the p.d. across the terminals of the battery during charging?

Q10. A current of 2mA is passed through a colour coded carbon resister with first, second and third rings of yellow, green and orange colours. What is voltage drop across the register?

Q11. A wire of 10 ohm resistance is stretched to thrice its original length. What will be its (i) new resistivity and (ii) new resistance?

Q12. A uniform copper wire of mass 2.23×10^{-3}kg carries a current of 1A when 1.7V is applied across it. Calculate its length and area of cross section .If the wire uniformly stretched to double its length. Calculate the new resistance. Density of copper is 8.92×10^{3} kg m^{-3} and resistivity is 1.7×10^{-8} Ω m.

Q13. Two cells of emf 6V and 12 V and internal resistance 1Ω and 2 Ω respectively are connected in parallel so as to send current in the same direction through an external resistance of 15 Ω**.** (i) Draw the circuit diagram (ii) using Kirchhoff's law calculate (a) current through each branch of the circuit (b) P.d across the 15 Ω resistance

Q14 .(a) In a potentiometer, a standard cell of emf 5V and of negligible resistance maintains a steady current through the potentiometer wire of length of 1m. Two primary cell of emf E1 and E2 are joined in series with (i)same polarity and (ii)opposite polarity.(b) The combination is connected through a galvanometer and a jockey to the potentiometer. The balancing length in the two cases are found to be 350 cm and 50 cm respectively.(i)Draw the necessary circuit diagram(ii) find the value of the emf's of the two cells.

Q17. In a metre-bridge experiment, with a resistance R1 in the left gap and a resistance X in the right gap, null point is obtained at 40cm from the left end. With resistance R2 in the left gap and the same resistance X in the right gap, null point is obtained at 50cm from the left end. Where will be the null point if R1 and R2 are put in series in the left gap containing X?

Q18. Two wires A and B of the same material have their lengths in the ration 1:5 and diameters in the ration 3:2. If the resistance of the wire B is 180 Ω, find the resistance of wire A.

Q19. A uniform wire is cut into four segments. Each segment is twice as long as their earlier segment. If the shortest segment has a resistance of 4Ω, find the resistance of the original wire.

Q20. A voltage of 30 V is applied across a colour coded carbon resistor with first, second and third rigs of blue, black and yellow colours. What is the current flowing through the resistor.

Q21. The resistance of a coil used in a platinum- resistance thermometer at 0^0C is 3.00Ω and at 100^0C is 3.75Ω. Its resistance at an unknown temperature is measured as 3.15Ω. calculate the unknown temperature.

Q22. The temperature coefficient of a resistance wire is 0.0012.5 $^0C^{-1}$. At 300K resistance is 1Ω . At what temperature the resistance of the wire will be 2Ω.

Q23. A cell gives a balance point with 85cm a potentiometer wire. When the terminals of the cell are shorted through a resistance of 7.5Ω, the balance is obtained at 75cm. find the internal resistance of the cell.

Q25. Calculate the temperature at which the resistance of conductor becomes 20% more than its resistance at 27^0C. the value of the temperature coefficient of resistance of the conductor is $2.0x10^{47}$K.

Q26. The temperature coefficient of a resistivity of copper is 0.004 ^{0}C-1. Find the resistance of a 5m long copper wire of diameter 0.2 mm at 100^0C, if the resistivity of copper at 0^0C is $1.7x10^{-8}$Ω.

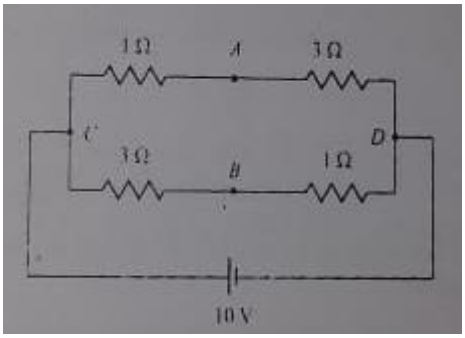
Q27.The current through a conductor is 1 ampere when the temperature is 0^0C and 0.7 ampere when the temperature is 100^0 C. What would be current when the temperature of conductor is 1200^0 C?

Q28. A set of identical resistors, each of resistance is RΩ, when connected in series have an effective resistance XΩ and when the resistors are connected in parallel, their effective resistance is YΩ. Find the relation between R,X and Y.

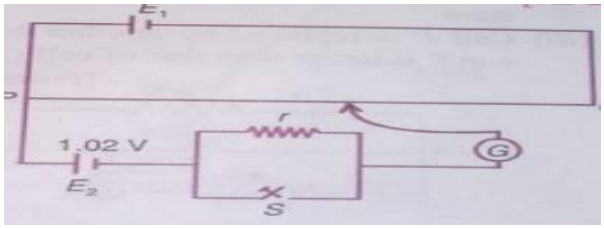
Q29. The length and radii of three wires of some metal are in the ratio of 2:3:4 and 3:4:5 respectively. They are joined in parallel and included a circuit having 5A current. Find current through each wire.

Q30. The length of a potentiometer wire is 600cm and it carries 40mA current. For a cell of emf 2 volt and internal resistance is 10 ohm, the null point is found at 500 cm. If a voltmeter is connected across the cell, the balancing length of the wire is decreased by 10cm. find (i) the resistance of the whole wire, (ii) reading of voltmeter and (iii) resistance of voltmeter.

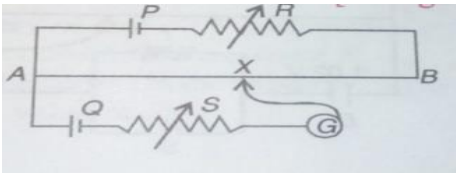
Q31. A battery of emf 10V is connected to resistances as shown in the following Fig. find the potential difference between the points A and B



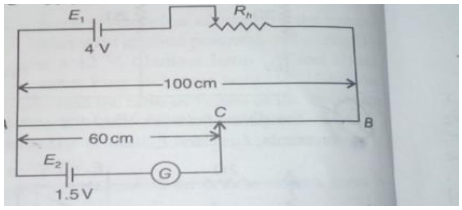
Q32 . Potentiometer wire , PQ of 1m length is connected to a standard cell E_1.Another cell , E_2 of e.m.f 1.02 V is connected as shown in the circuit diagram with a resistance 'r' and a switch ,S. When switch , S open, null position is obtained at a distance of 51 cm from P. Calculate (1) potential gradient of the potentiometer wire and (2) e.m.f. of the cell E_1.(3) When switch S is closed , will null point move towards P or towards Q? Give reason for your answer.



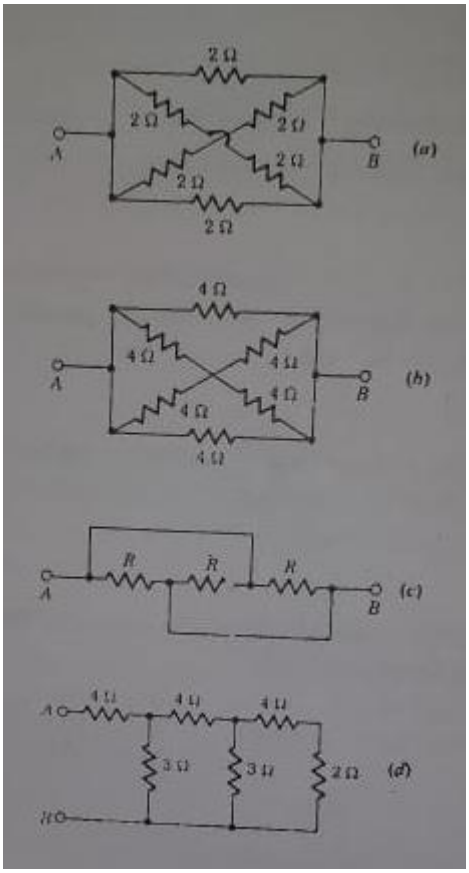
Q33. In the potentiometer circuit shown ,the balance (null) point is at X. State with reason , where the balance point will be shifted when(i) Resistance R is increased ,keeping all parameters unchanged.(ii) Resistance S is increased ,keeping R constant.(iii) Cell P is replaced by another cell whose e.m.f. is lower than that of cell Q.



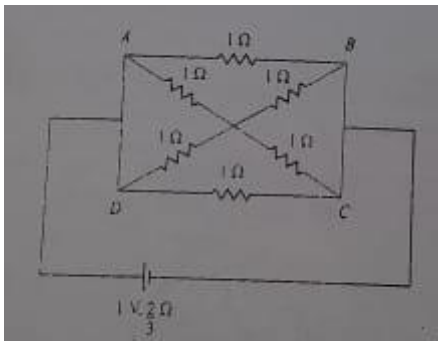
Q34. What is meant by the sensitivity of a potentiometer? A battery E_1 of 4 V and a variable resistance R_h are connected in series with the wire AB of the potentiometer .the length of the wire of the potentiometer is meter. When a cell E_2 of e.m.f. 1.5 volt is connected between points A and C , no current flows through E_2 . Length of AC= 60 cm.(a) Find the p.d. between ends A and B of the potentiometer (b) Would the method work if the battery $E_1$is replaced by a cell of emf 1V?



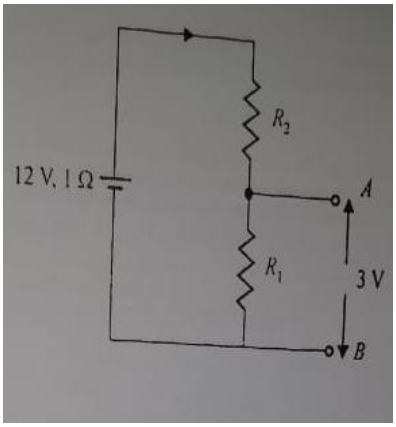
Q35. Calculate the resistance between points A and B for the following networks.



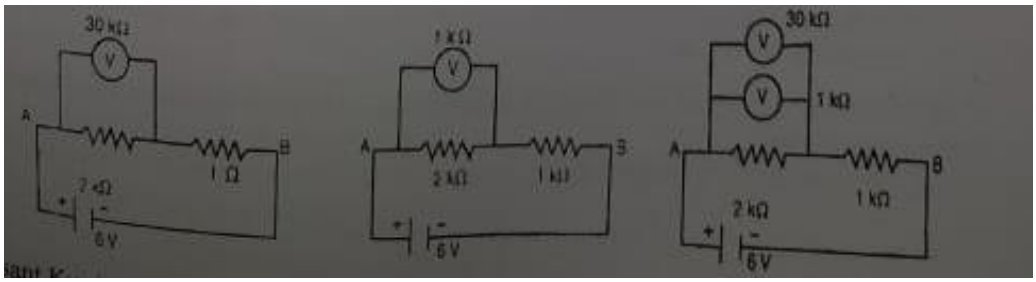
Q36. Find the current drawn from a cell of emf 1 V and internal resistance 2/3Ω connected to the network given below



Q37. In the circuit shown in the following figure a potential difference the points A and B is 3V. Find the value of resistance R.

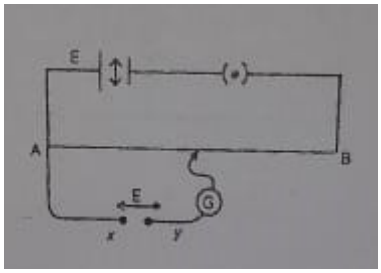


Q38. A series combination of a 2kΩ resistor and 1kΩ resistor, is connected across a battery of emf6V and negligible internal resistance. The potential drop, across the 2kΩ resistor is measured by (i) a 30 kΩ Voltmeter (ii) a 1 kΩ Voltmeter and (iii) Both these Voltmeter connected across. If the voltmeter reading in the three cases are V_1, V_2 and V_3 respectively, arrange these readings in descending order.



How will the three readings compare the one another if the potential drop were measured across the series combination of the 2kΩ and the 1kΩ resistor i. e. across the point A and B.

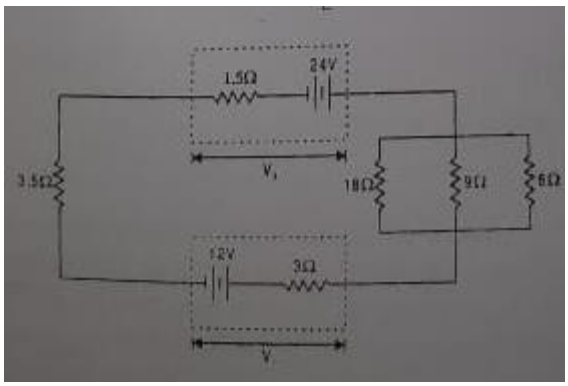
Q39. For a potentiometer circuit shown in the given figure, points X and Y represent the two terminals of an unknown emf E. A student observed that when the jockey is moved from the end A to the end B of the potentiometer wire, the deflection in the galvanometer remain in the same direction. What are the two possible faults in the circuit that could result in this observation ?



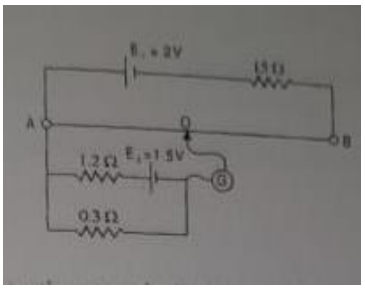
In the galvanometer deflection at the B is (i)More(ii)less than at the end A, which of the two faults, listed above, would be there in the circuit? Give reasons in support of your answer in each case.

Q40. A 24 V battery of internal resistance 1.5Ω is connected to three coils of resistance 18Ω, 9Ω and 6Ω in parallel, a resistor of 3.5Ωand reversed battery (emf. 12 V and internal

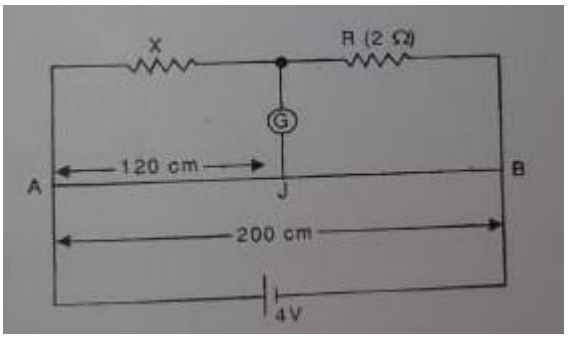
resistance = 3Ω) as shown. Calculate (i) the current in the circuit (ii) current in resistor of 18Ω coil and (iii) p.d. across each battery



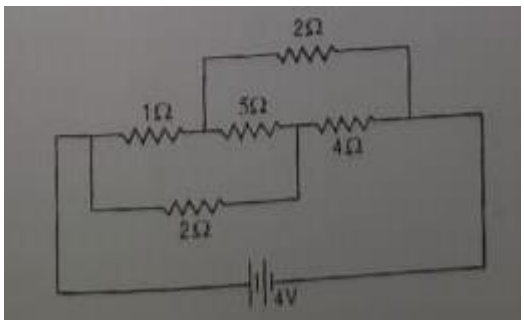
Q41. AB is one metre long uniform wire of 10Ω resistance. The other data are shown in the following circuit diagram given below .Calculate (i) Potential gradient along AB, and (ii) length AO of the wire, when the galvanometer shows no deflection.



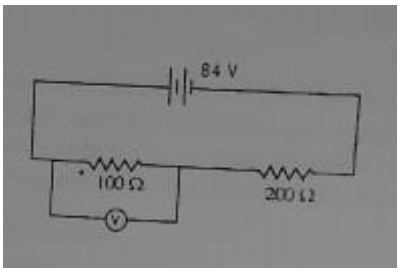
Q41. Find the value of unknown resistance X and the current drawn by the circuit from the battery, if no current flows through the galvanometer. Assume the resistance per unit length of wire AB to be 0.01 Ω/cm.



Q42. Calculate the current drawn from the battery in the given network sketched here.



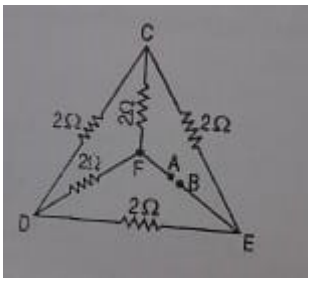
Q43. A voltmeter V of resistance 400Ω is used to measure the potential difference across a 100 Ω resistor in the circuit shows here (a) What will be the reading on the voltmeter?(b) Calculate the potential difference across 100 Ω resistor before the voltmeter is connected.



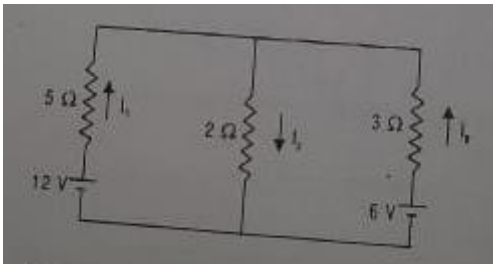
Q44. A potential difference of 2 volt is applied between the points A and B as shown in the network drawn in the figure. Calculate

(i) Equivalent resistance of the network across a point A and B, and

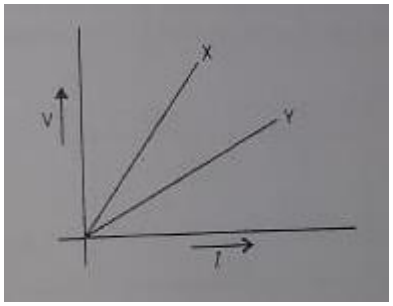
(ii) the magnitudes of the current flowing in the arms AFCEB and AFDEB.



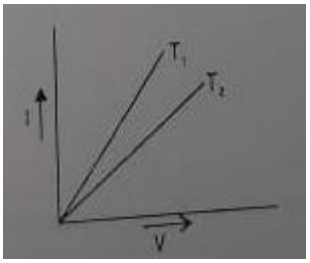
Q45. Using Kirchhoff's law in the given electrical network calculate the value of I_1, I_2 and I_3



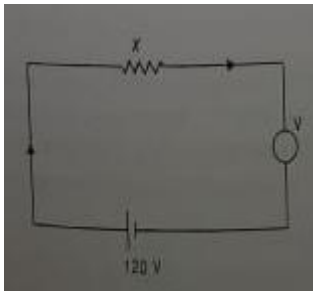
Q46. the variation of potential difference V with length l in case of two potentiometer X and Y is as shown in the given diagram. Which one of these two will you prefer for comparing emf's of two cells and why?



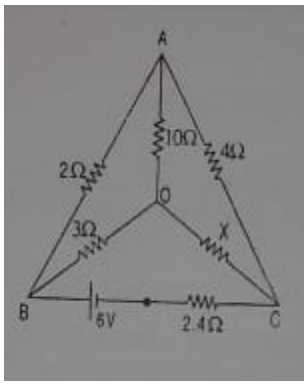
Q47. V-I graph for a metallic wire at two different temperature T1 and T2 is as shown in the following figure. Which of the two temperature is higher and why?



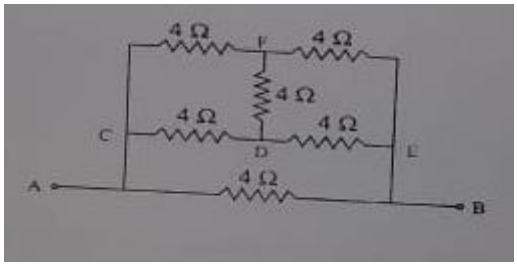
Q48. A d.c supply of 120V is connected to a large resistance X. A voltmeter of resistance 10kΩ Placed in series in the circuit needs 4V. What is the value of X ? What do you thing is the purpose in using a voltmeter instead of an ammeter, to determine the large resistance X?



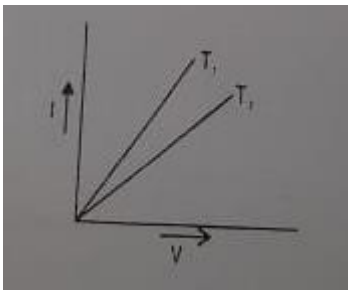
Q49. Find the value of the network resistance X, in the following circuit, if no current flows through the section AO. Also calculate the current drawn by the circuit from the battery of emf. 6V and negligible internal resistance.



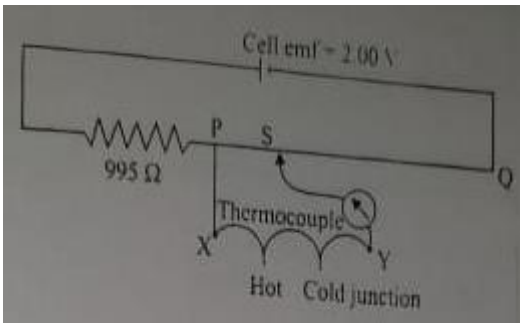
Q50. Six resistors each of value 4Ω are joined together in a circuit as shown in the figure. Calculate equivalent resistance across the points A and B. If a cell of emf. 2V is connected across AB, complete the current through the arms AB and DF of the circuit.



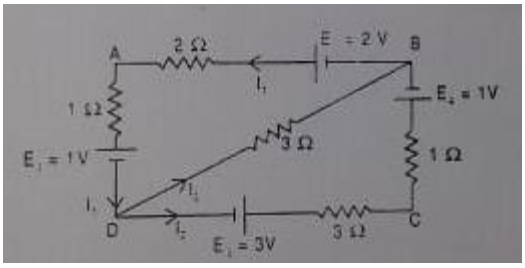
Q51. The voltage- current variation of two metallic wires X and Y at constant temperature are as shown. Assuming that the wires have the same length and the same diameter, explain which of the two wires will have larger resistivity?



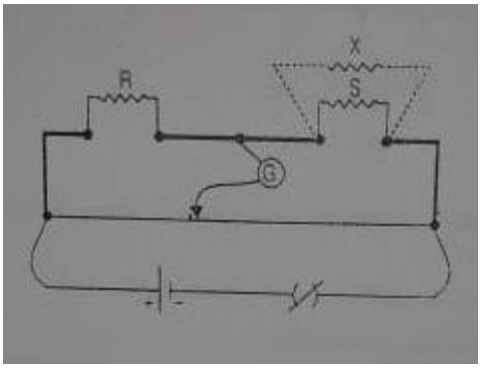
Q52. The circuit diagram shows the use of a potentiometer to measure a small emf production by a thermocouple connected between X and Y, the cell C of emf 2V has negligible internal resistance. The potentiometer wire PQ is 1.00m long and the resistance is 5Ω. The balance point is found to be 400mm from P. calculate the value of emf V, generated by the thermocouple.



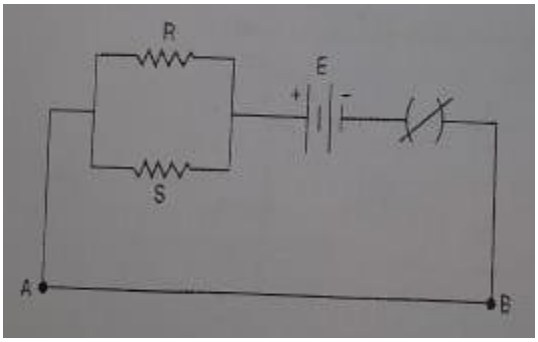
Q53. In the potentiometer circuit shown, the balance (null) point is at X. state with reason, where the balance point will be shifted when.(i) Resistance R is increased, keeping all parameters unchanged. (ii) Resistance S is increased, keeping R constant.(iii) Cell P is replaced by another cell whose e.m.f. is lower than that the cell Q.



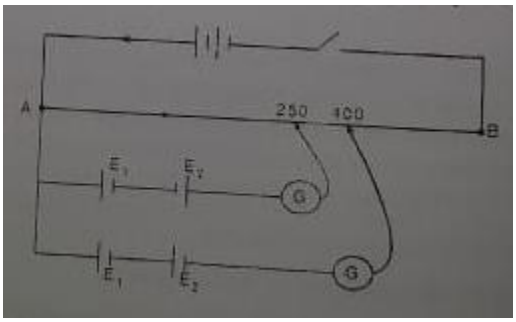
Q54. When two known resistance R and S are connected in the left and right Gaps of a meter bridge, the balance point is found at a distance l1 from the 'zero end' of the meter bridge wire. An unknown resistance X is now connected in parallel to the resistance S and the balance point is now found at distance l2 from the zero end of the meter bridge wire. Obtain a formula for X in terms of l_1,l_2 and S.



Q55. A potentiometer wire has a length L and Resistance R_0. it is connected to a battery and a resistance combination as shown. Obtain an expression for the potential per length of the potentiometer wire.What is the maximum emf of a 'test cell' for which one can get a 'balance point' on this potentiometer wire? What precaution should one take, while connecting this test cell in the circuit?

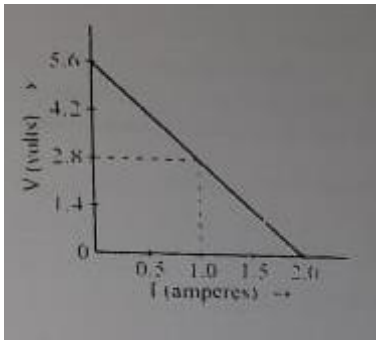


Q56. Two primary cell of emf E1 and E2 (E1 > E2) are connected to the potentiometer wire AB as shown in the figure



If the balancing lengths for the combinations of the cells are 250cm and 400cm, find the ratio of E1and E2.

Q57. 4 cells of identical emf E internal resistance E1 are connected in series to a variable resistor. The following graph shows the variation of terminal voltage of combination with the current output.

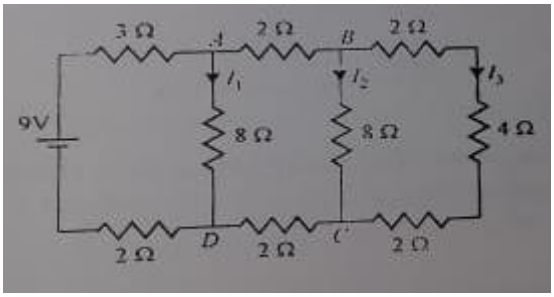


(i) What is emf of each cell used?

(ii) For what current from the cell, does maximum power dissipation occur in the circuit?

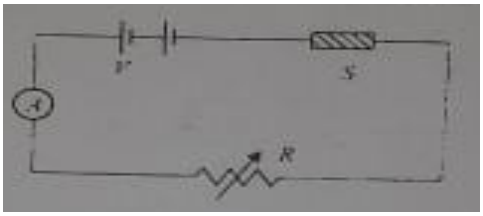
(iii) Calculate the internal resistance of each cell.

Q58.In the circuit shown in the fig. find the current through the 4Ω resistor.

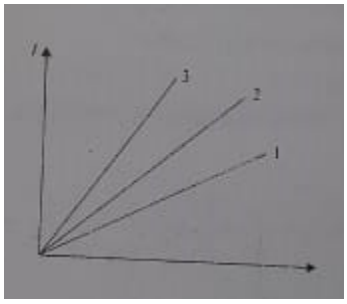


Q59. Fig. shows a cell of emf E and internal resistance r., connected to a voltmeter V and a variable resistance R. Deduce the relationship among V,E,R and r. How will V vary when R is reduced?

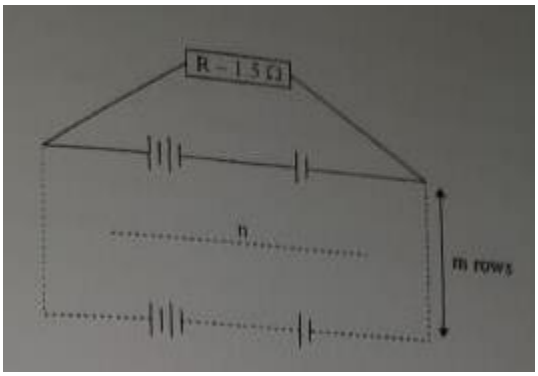
Q60. The diagram shows a piece of pure semiconductor, S in series with a variable resistor R, and a source of constant voltage V, would you increase or decrease the value of R to keep the reading of ammeter (A) constant, when semiconductor S is heated? Give reason.



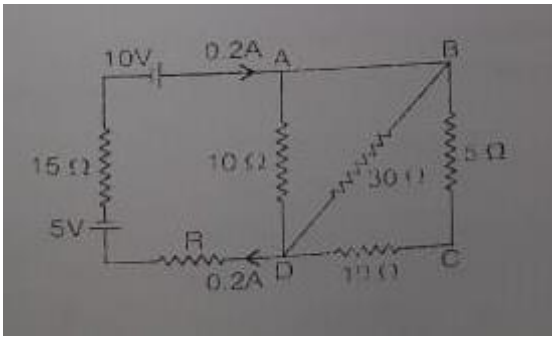
Q61. the V-I graphs of two resistors and their series combination, are shown in the following figure. Which one of these graphs represents the series combination of the other two? Give reason for your answer.



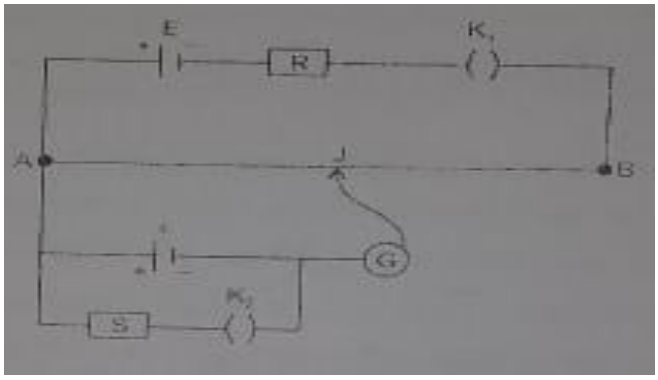
Q62. 12 cells, each of emf 1.5V and internal resistance 0.5Ω, are arranged in m rows each containing n cells connected in series, as shown in the fig. Calculate the values of n and m for which this combination would send maximum current through an external resistance of 1.5Ω.



Q63. calculate the value of the resistance R in the circuit shown in the figure so that he current in the circuit in 0.2 A. what should be the potential difference between points A and D?

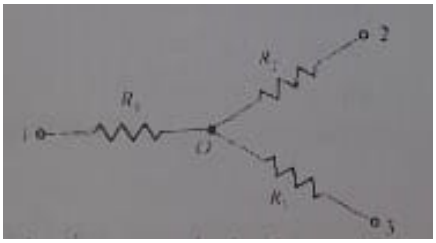


Q65. Two students X and Y perform an experiment on potentiometer separately using the circuit given below

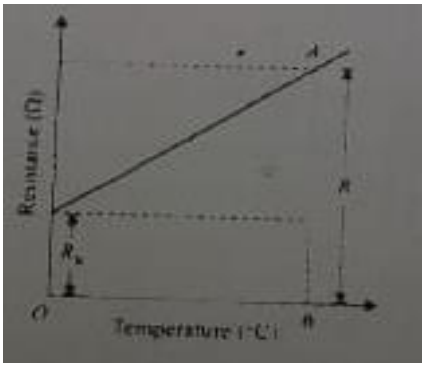


Keeping other parameter changed how will the position of the null point be affected of (i) X increase the value of resistance R in the set up by keeping the key k1 closed and the key k2 open ? (ii) Y decreases the value of resistance S in the set up, while the key K2 remains open and the key K1 closed ?

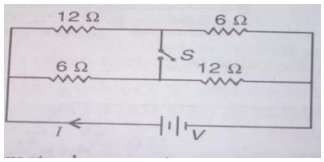
Q66. Find the current flowing through the resistance R of the circuit shown in the fig. given R_1=10, R_2 = 20 and R_3=30 and the potentials of point 1, 2 and 3 are 10V, 6V and 5V.



Q67.The variation of the resistance of a metallic conductor with temperature is shown in the figure (i) Calculate the temperature coefficient of resistance from the graph.(ii) State why the resistance of the conductor increases with the rise in temperature

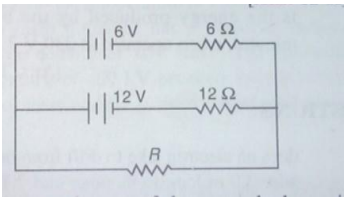


Q68. With switch S open ,the network of resistors shown here drawn a current I from the battery. How many times will this current become on closing the switch S?



Q68.E.M.F. of a cell is 1.5 V And its internal resistance is 1 Ω For what current drawn from the cell will its terminal potential difference be half of its e.m.f. ?

Q69. In the circuit diagram shown here what should be the value of R so that there is no current in the branch containing 6 V battery ?



Q70. Two identical cells of e.m.f. 1.5 V each joined in parallel provide supply to an external circuit consisting of two resistors of 17 Ω each joined in parallel. A very high resistance voltmeter reads the terminal voltage of the cells to be 1.4 V. What is the internal resistance of each cell?

Hots –

Q.1. Two conductors with resistance R and 2R respectively are connected individually, in parallel and in series to (i) a dc source (ii) an ac source.

The rate of heat produced in the four cases are Q_1, Q_2, Q_3 and Q_4. Calculate the ratio $Q_1:Q_2:Q_3:Q_4$ in each case.

Q.2. Two resistors of 10 Ω and 20 Ω are connected in turn to same source (i) in series (ii) in parallel.

Which of the two resistors consumes more power?

Justify your answer.

Q.3. Justify the precaution, "Pass the current for minimum possible time" in Ohm's law experiment.

A student is given two black boxes 'A' and 'B' containing resistors of two different materials. The student fails to observe the above precaution while determining the value of resistances.

For 'A' he get decreasing values whereas for B he gets increasing values of R.

Identify the nature of materials A and B. Justify your answer.

Q.4. Calculate the equivalent resistance of the circuit between A and B when

(i) Switch S is open (ii) Switch S is closed.

Q.5. A battery consists of an incidental cell each of emf E and internal resistance are connected in series. The number of cells is varied and each time the terminals of the battery are short-circuited and the current I recorded represent graphically the variation of I with n.

Q.6. The variation of potential difference V with length l in case of two potentiometers P and Q is as shown. Which one of these two potentiometers is more sensitive?

Q.7. A cell of emf 1.5 V and internal resistant 0.5 Ω is connected to a non-linear device. The V -I graph for the conductor is as shown. Obtain the current drawn from the cell and its terminal voltage.

Q.8. Four sets of identical emf E, internal resistance are all connected in series to a variable resistance. The graph shows the variation of thermal voltage of the combination with the current output:

(i) What is the emf of each cell use?

(ii) For what current from the cells, does maximum power dissipation occur in the circuit.

(iii) Calculate the internal resistance of each cell.

Q.9. The following graph shows variation of current with applied voltage for the different devices. Identify the devices. Give one special feature of each graph.

Mark negative resistance region in the graphs if any.

Q10. Calculate the effective resistance of the infinite series of resistance shown between points A and B.

Q.11. Two resistances X and Y are individually connected to a source of certain potential difference. The current through X is recorded to be twice that through Y.

Calculate the ratio of the currents drawn from the source when the two resistors are connected together

(a) in series

(b) in parallel to the same source.

Q12. A potentiometer wire AB has a length L and A resistance R_0. It is connected to a battery and a resistance combination as shown. Obtain an expression for the potential drop per unit length of this potential meters wire. What is the maximum emf of a test cell for which one can get a balance point on this potentiometer wire. What precaution should one take while connecting the cell in the circuit?

Q.13. For students W, X, Y and Z perform an experiment on potentiometer separately using the circuit diagram shown here.

Keeping other things unchanged

(i) W replaces E by a cell of higher value emf.

(ii) X increases the value of resistance R.

(iii) Y decreases the value of resistance S in the setup.

Q.14. 24 cells each of emf 1.5 V and internal resistance of 0.5 Ω, are arranged in rows each containing n cells connected in series as shown. Calculate the values of n and m for which this combination would send maximum current through an external resistance of 0.75 Ω. Calculate the maximum current also. What is power output of external resistance?

Q.15. When two unknown resistances R and S, are connected in the left and right gaps of the metre-bridge, the balance point is found to be at a distance L_1 from the zero end of the metre-bridge wire. An unknown resistance X is now connected in parallel to the resistance S and the balance point is now found at a distance l_2 from the zero end of the metre-bridge wire. Obtain a formula for X in terms of L_1, L_2 and S.

Q.16. The circuit diagram shows the user potentiometer to measure a small emf produced by the thermocouple connected between X and Y. The cell, of emf 2 V, has negligible internal resistance. The potentiometer wire PQ is 1.00 m long and has resistance 5 Ω. The balance point S is found to be 400 mm from P. Calculate the value of emf V, generated by the thermocouple.

Q.17. A battery of 10 V and negligible internal resistance is connected across the diagonally opposite corners of the cubicle network of 12 resistors each of resistance 1 Ω in figure. Determine the equivalent resistance of the network and the current along each edge of the cube.

Q.18. A wire of uniform area of cross-section has a resistance of 20 Ω. It is bent in the form of a circular loop. A 2 V, 1 Ω battery is connected between points A and B. Calculate the current drawn from the battery.

Q.19. Nichrome and copper wires of the same length and same radius are connected in series. Current I is passed through them.

What changes if any will be observed if the wires are connected in parallel across a voltage source?