Topicwise Questions

Microscopic Analysis, Drift Velocity Ohm's Law Conductivity

1. There is a current of 40 ampere in a wire of 10^{-6} m^2 area of cross-section. If the number of free electron per m^3 is 10^{29}, then the drift velocity will be
(*a*) 1.25×10^{3} m/s (*b*) 2.50×10^{-3} m/s
(*c*) 25.0×10^{-3} m/s (*d*) 250×10^{-3} m/s

2. When current flows through a conductor, then the order of drift velocity of electrons will be
(*a*) 10^{10} m/sec (*b*) 10^{-2} cm/sec
(*c*) 10^{4} cm/sec (*d*) 10^{-1} cm/sec

3. Every atom has one free electron in copper. If 1.1 ampere current is flowing in the wire of copper having 1 mm diameter, then the drift velocity (approx.) will be (Density of copper = 9×10^{3} kg m^{-3} and atomic weight = 63)
(*a*) 0.3 mm/sec (*b*) 0.1 mm/sec
(*c*) 0.2 mm/sec (*d*) 0.2 cm/sec

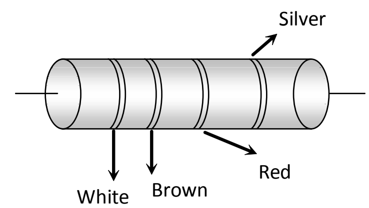
4. Drift velocity v_d varies with the intensity of electric field as per the relation
(*a*) $v_d \propto E$ (*b*) $v_d \propto \frac{1}{E}$
(*c*) v_d = constant (*d*) $v_d \propto E^2$

5. A certain wire has a resistance R. The resistance of another wire identical with the first except having twice its diameter is
(*a*) 2R (*b*) 0.25R
(*c*) 4R (*d*) 0.5R

6. A metallic block has no potential difference applied across it, then the mean velocity of free electrons is T = absolute temperature of the block)
(*a*) Proportional to T
(*b*) Proportional to $\sqrt{T}$
(*c*) Zero
(*d*) Finite but independent of temperature

7. A uniform wire of resistance R is uniformly compressed along its length, until its radius becomes n times the original radius. Now resistance of the wire becomes
(*a*) $\frac{R}{n^4}$ (*b*) $\frac{R}{n^2}$
(*c*) $\frac{R}{n}$ (*d*) nR

8. In the figure a carbon resistor has bands of different colours on its body as mentioned in the figure. The value of the resistance is

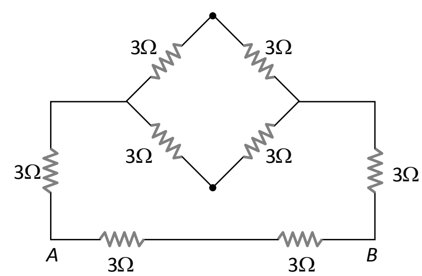


(*a*) 2.2 $k\Omega$ (*b*) 3.3 $k\Omega$
(*c*) 5.6 $k\Omega$ (*d*) 9.1 $k\Omega$

Series and Parallel Combination of Resistance

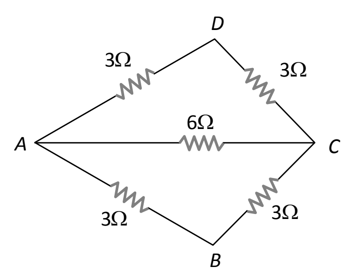
9. There are 8 equal resistances R. Two are connected in parallel, such four groups are connected in series, the total resistance of the system will be
(*a*) R/2 (*b*) 2R
(*c*) 4R (*d*) 8R

10. Equivalent resistance between A and B will be



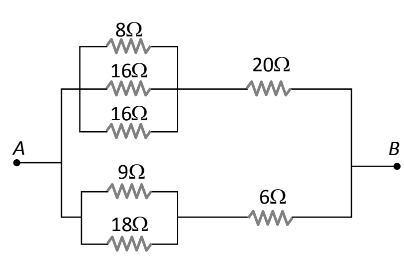
(*a*) 2 Ω (*b*) 18 Ω
(*c*) 6 Ω (*d*) 3.6 Ω

11. The effective resistance between the points A and B in the figure is



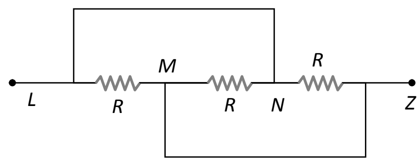
(*a*) 5Ω (*b*) 2Ω
(*c*) 3Ω (*d*) 4Ω

12. The equivalent resistance of the arrangement of resistances shown in adjoining figure between the points A and B is



(*a*) 6 Ω (*b*) 8 Ω
(*c*) 16 Ω (*d*) 24 Ω

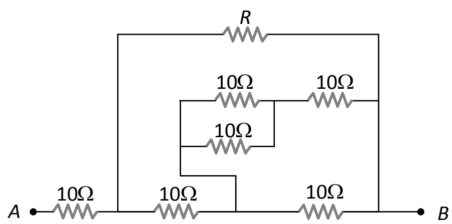
13. Three equal resistances each of value R are joined as shown in the figure. The equivalent resistance between M and N is



(a) R (b) $2R$

(c) $\frac{R}{2}$ (d) $\frac{R}{3}$

14. For what value of R the net resistance of the circuit will be $18\,\Omega$



(a) 8Ω (b) 10Ω

(c) 16Ω (d) 24Ω

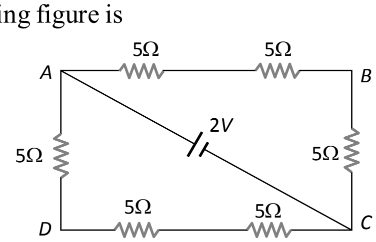
15. Two wires of equal diameters, of resistivities ρ_1 and ρ_2 and lengths l_1 and l_2, respectively, are joined in series. The equivalent resistivity of the combination is

(a) $\frac{\rho_1 l_1 + \rho_2 l_2}{l_1 + l_2}$ (b) $\frac{\rho_1 l_2 + \rho_2 l_1}{l_1 - l_2}$

(c) $\frac{\rho_1 l_2 + \rho_2 l_1}{l_1 + l_2}$ (d) $\frac{\rho_1 l_1 - \rho_2 l_2}{l_1 - l_2}$

Problem Solving using Ohm's Law

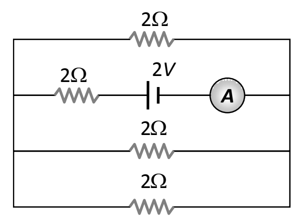
16. The potential difference between points A and B of adjoining figure is



(a) $\frac{2}{3}$V (b) $\frac{8}{9}$V

(c) $\frac{4}{3}$V (d) 2V

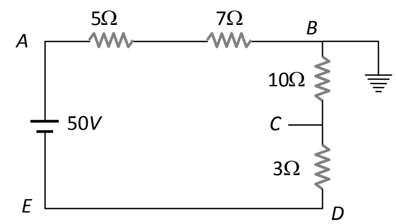
17. The reading of the ammeter as per figure shown is



(a) $\frac{1}{8}$A (b) $\frac{3}{4}$A

(c) $\frac{1}{2}$A (d) 2A

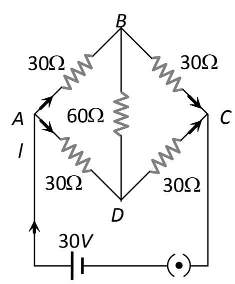
18. In the circuit shown, the point 'B' is earthed. The potential at the point 'A' is



(a) 14V (b) 24V

(c) 26V (d) 50V

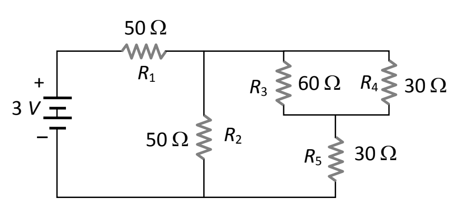
19. The current between B and D in the given figure is



(a) 1 amp (b) 2 amp

(c) Zero (d) 0.5 amp

20. In circuit shown below, the resistances are given in ohms and the battery is assumed ideal with emf equal to 3 *volt*. The voltage across the resistance R_4 is

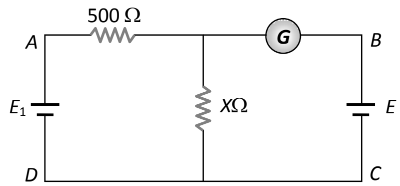


(a) 0.4 V (b) 0.6 V

(c) 1.2 V (d) 1.5 V

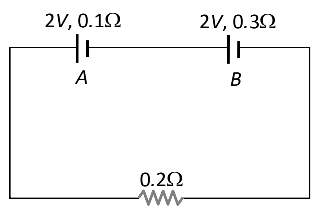
Kirchoff's Law and Equivalent Battery

21. In the adjoining circuit, the battery E_1 has an e.m.f. of 12 volt and zero internal resistance while the battery E has an e.m.f. of 2 volt. If the galvanometer G reads zero, then the value of the resistance X in ohm is



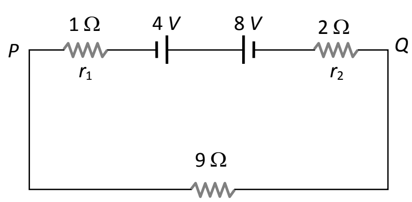
(*a*) 10 (*b*) 100
(*c*) 500 (*d*) 200

22. The internal resistances of two cells shown are 0.1 Ω and 0.3 Ω. If R = 0.2Ω, the potential difference across the cell



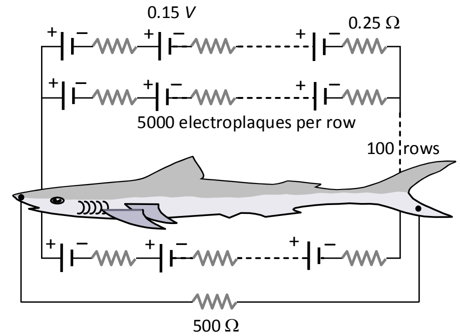
(*a*) *B* will be zero
(*b*) *A* will be zero
(*c*) *A* and *B* will be 2*V*
(*d*) *A* will be > 2V and *B* will be < 2V

23. Two batteries of e.m.f. 4V and 8 V with internal resistances 1 Ω and 2 Ω are connected in a circuit with a resistance of 9 Ω as shown in figure. The current and potential difference between the points P and Q are



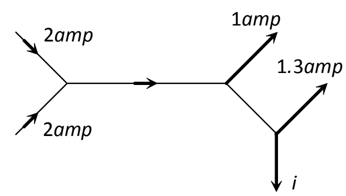
(*a*) $\frac{1}{3}$A and 3V (*b*) $\frac{1}{6}$A and 4V
(*c*) $\frac{1}{9}$A and 9V (*d*) $\frac{1}{2}$A and 12V

24. Eels are able to generate current with biological cells called electroplaques. The electroplaques in an eel are arranged in 100 rows, each row stretching horizontally along the body of the fish containing 5000 electroplaques. The arrangement is suggestively shown below. Each electroplaques has an emf of 0.15 V and internal resistance of 0.25 Ω



The water surrounding the eel completes a circuit between the head and its tail. If the water surrounding it has a resistance of 500 Ω, the current an eel can produce in water is about
(*a*) 1.5 A (*b*) 3.0 A
(*c*) 15 A (*d*) 30 A

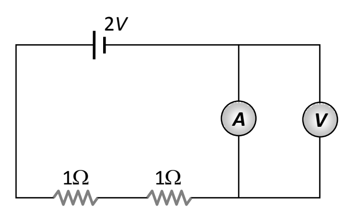
25. The figure below shows currents in a part of electric circuit. The current *i* is



(*a*) 1.7 amp (*b*) 3.7 amp
(*c*) 1.3 amp (*d*) 1 amp.

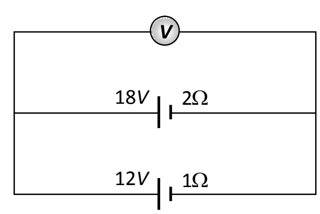
Current Measuring Instrument

26. In the circuit shown, A and V are ideal ammeter and voltmeter respectively. Reading of the voltmeter will be



(*a*) 2V (*b*) 1V
(*c*) 0.5V (*d*) Zero

27. Two batteries, one of emf 18 volts and internal resistance 2Ω and the other of emf 12 volt and internal resistance 1Ω, are connected as shown. The voltmeter V will record a reading of



(*a*) 15 volt (*b*) 30 volt
(*c*) 14 volt (*d*) 18 volt

28. In meter bridge or Wheatstone bridge for measurement of resistance, the known and the unknown resistances are interchanged. The error so removed is)

(*a*) End correction (*b*) Index error

(*c*) Due to temperature effect (*d*) Random error

29. A galvanometer can be converted into an ammeter by connecting

(*a*) Low resistance in series

(*b*) High resistance in parallel

(*c*) Low resistance in parallel

(*d*) High resistance in series

30. A 2 volt battery, a 15Ω resistor and a potentiometer of 100 cm length, all are connected in series. If the resistance of potentiometer wire is 5Ω, then the potential gradient of the potentiometer wire is

(*a*) 0.005 V/cm (*b*) 0.05 V/cm

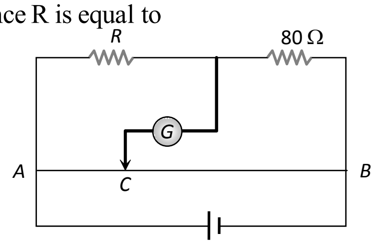
(*c*) 0.02 V/cm (*d*) 0.2 V/cm

31. An ammeter of 5 ohm resistance can read 5 mA. If it is to be used to read 100 volts, how much resistance is to be connected in series

(*a*) 19.9995Ω (*b*) 199.995Ω

(*c*) 1999.95Ω (*d*) 19995Ω

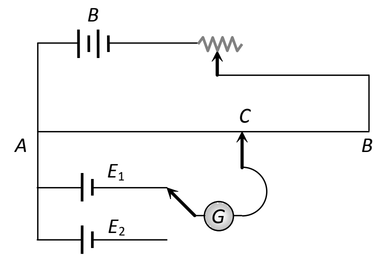
32. AB is a wire of uniform resistance. The galvanometer G shows no current when the length AC = 20cm and CB = 80 cm. The resistance R is equal to



(*a*) 2Ω (*b*) 8Ω

(*c*) 20Ω (*d*) 40Ω

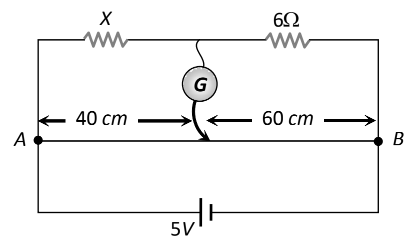
33. The circuit shown here is used to compare the e.m.f. of two cells E_1 and $E_2 (E_1 > E_2)$. The null point is at C when the galvanometer is connected to E_1. When the galvanometer is connected to E_2, the null point will be



(*a*) To the left of C (*b*) To the right of C

(*c*) At C itself (*d*) Nowhere on AB

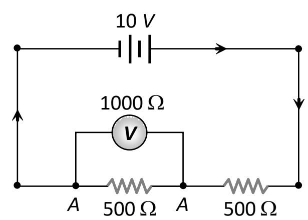
34. In the circuit shown, a meter bridge is in its balanced state. The meter bridge wire has a resistance 0.1 Ω/cm. The value of unknown resistance X and the current drawn from the battery of negligible resistance is



(*a*) 6 Ω, 5 amp (*b*) 10 Ω, 0.1 amp

(*c*) 4 Ω, 1.0 amp (*d*) 12 Ω, 0.5 amp

35. What is the reading of voltmeter in the following figure



(*a*) 3V (*b*) 2V

(*c*) 5V (*d*) 4V

Learning Plus

1. 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 $\vec{E}$.

2. A current (I)flows through a uniform wire of diameter (d) when the mean drift velocity is V. The same current will flow through a wire of diameter d/2 made of the same material if the mean drift velocity of the electron is

(*a*) V/4

(*b*) V/2

(*c*) 4V

(*d*) 2V

3. A steady current is passing through a linear conductor of non-uniform cross-section. The current density in the conductor is

(*a*) independent of area of cross-section
(*b*) directly proportional to area of cross-section
(*c*) inversely proportional to area of cross-section
(*d*) inversely proportional to the square root of area of cross-section

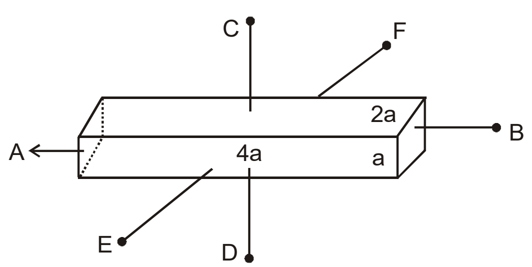
4. The resistance of wire is 20Ω. The wire is stretched to three times its length. Then the resistance will now be

(*a*) 6.67 Ω (*b*) 60 Ω
(*c*) 120 Ω (*d*) 180 Ω

5. In order to increase the resistance of a given wire of uniform cross section to four times its value, a fraction of its length is stretched uniformly till the full length of the wire becomes $\frac{3}{2}$ $I = neAv_d$ times the original length what is the value of this fraction?

(*a*) $\frac{1}{4}$ (*b*) $\frac{1}{8}$
(*c*) $\frac{1}{16}$ (*d*) $\frac{1}{6}$

6. A conductor with rectangular cross section has dimensions $(a \times 2a \times 4a)$ as shown in figure. Resistance across AB is x, across CD is y and across EF is z. Then



(*a*) x = y = z (*b*) x > y > z
(*c*) y > z > x (*d*) x > z > y

7. In a wire of cross-section radius r, free electrons travel with drift velocity v when a current I flows through the wire. What is the current in another wire of half the radius and of the same material when the drift velocity is 2v ?

(*a*) 2I (*b*) I
(*c*) I/2 (*d*) I/4

8. Two coils connected in series have resistances 600 Ω and 300 Ω at 20°C and temperature coefficient of resistivity 0.001 K^{-1} and 0.004 K^{-1} respectively.
The resistance of the combination at temperature 50°C is

(*a*) 426 Ω (*b*) 954 Ω
(*c*) 1806 Ω (*d*) 214 Ω

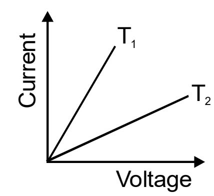
9. Two coils connected in series have resistances 600 Ω and 300 Ω at 20°C and temperature coefficient of resistivity 0.001 K^{-1} and 0.004 K^{-1} respectively.
The effective temperature coefficient of the combination is

(*a*) $\frac{1}{1000}$ degree^{-1} (*b*) $\frac{1}{250}$ degree^{-1}
(*c*) $\frac{1}{500}$ degree^{-1} (*d*) $\frac{3}{1000}$ degree^{-1}

10. Two wires of the same material having radii in has the ratio 1:2, carry currents in the ratio 4 : 1. The ratio of drift velocities of electrons in them is:

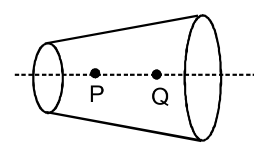
(*a*) 1:16 (*b*) 16:1
(*c*) 1:4 (*d*) 4:1

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



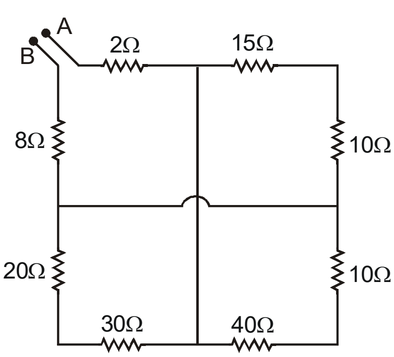
(*a*) $T_1 > T_2$ (*b*) $T_1 < T_2$
(*c*) $T_1 = T_2$ (*d*) none

12. A wire has a non-uniform cross-section as shown in figure. A steady current flows through it. The drift speed of electrons at points P and q is v_p and v_q



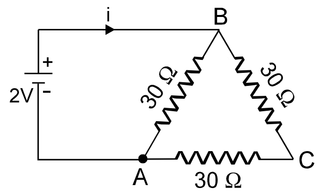
(*a*) $v_p = v_q$ (*b*) $v_p < v_q$
(*c*) $v_p > v_q$ (*d*) Data insufficient

13. The equivalent resistance between points A and B is :



(*a*) $\frac{65}{2}\Omega$ (*b*) $\frac{45}{2}\Omega$
(*c*) $\frac{5}{2}\Omega$ (*d*) $\frac{91}{2}\Omega$

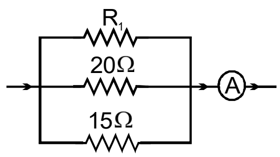
14. The current i in the circuit of figure is -



(*a*) $\frac{1}{45}$ amp. (*b*) $\frac{1}{15}$ amp.

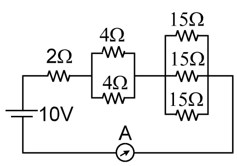
(*c*) $\frac{1}{10}$ amp. (*d*) $\frac{1}{5}$ amp.

15. In the given circuit the current flowing through the resistance 20 ohms is 0.3 ampere while the ammeter reads 0.8 ampere. What is the value of R_1 ?



(*a*) 30 ohms (*b*) 40 ohms
(*c*) 50 ohms (*d*) 60 ohms

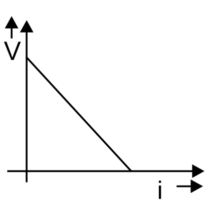
16. The current through the ammeter shown in figure is 1 A. If each of the 4Ω resistor is replaced by 2Ω resistor, the current in circuit will become nearly :

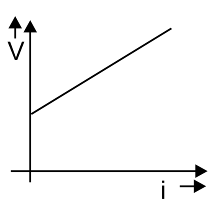


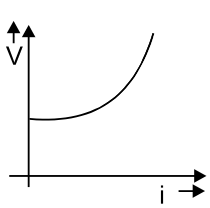
(*a*) $\frac{10}{9}$ A (*b*) $\frac{5}{4}$

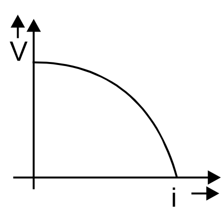
(*c*) $\frac{9}{8}$ A (*d*) $\frac{5}{8}$ A

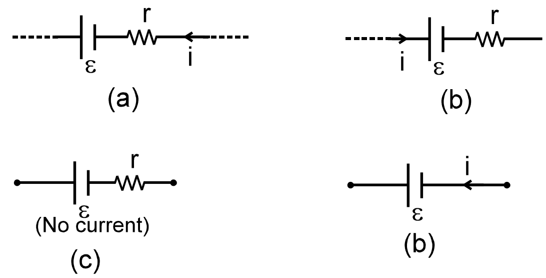
17. If internal resistance of a cell is proportional to current drawn from the cell. Then the best representation of terminal potential difference of a cell with current drawn from cell will be:

(*a*)


(*b*)


(*c*)


(*d*)


18.


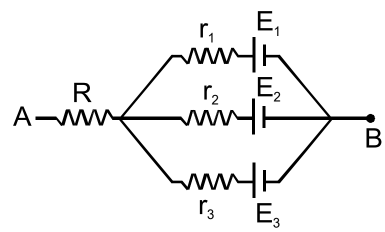
In which of the above cells, the potential difference between the terminals of a cell exceeds its emf.

(*a*) a (*b*) b
(*c*) c (*d*) d

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

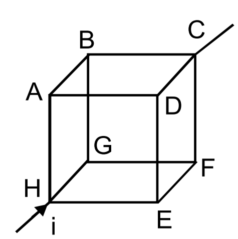
(*a*) 13 Volts (*b*) 12.5 Volts
(*c*) 12 Volts (*d*) 1.5 Volts

20. In the network shown the potential difference between A and B is ($R = r_1 = r_2 = r_3 = 1\ \Omega$, $E_1 = 3$ V, $E_2 = 2$ V, $E_3 = 1$ V)



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

21. In the box shown current i enters at H and leaves at C. If $i_{AB} = \frac{i}{6}$, $i_{DC} = \frac{2i}{3}$, $i_{HA} = \frac{i}{2}$, $i_{GF} = \frac{i}{6}$, $i_{HE} = \frac{i}{6}$, choose the branch in which current is zero



(*a*) BG (*b*) FC
(*c*) ED (*d*) none

22. If 2 bulbs rated 2.5 W – 110 V and 100 W – 110 V are connected in series to a 220 V supply then

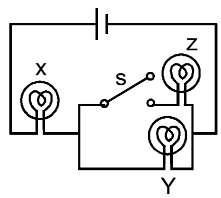
(*a*) 2.5 W bulb will fuse (*b*) 100 W bulb will fuse
(*c*) both will fuse (*d*) both will not fuse

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

(*a*) $\frac{H}{n^2}$ (*b*) n^2H

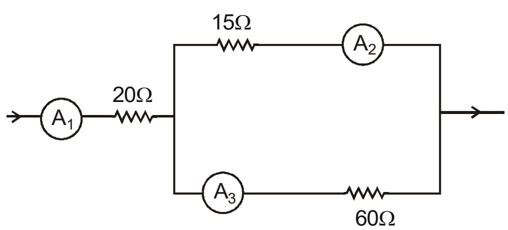
(*c*) nH (*d*) $\frac{H}{n}$

24. If X, Y and Z in figure are identical lamps, which of the following changes to the brightnesses of the lamps occur when switch S is closed ?



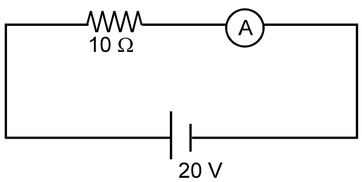
(*a*) X stays the same, Y decreases
(*b*) X increases, Y decreases
(*c*) X increases, Y stays the same
(*d*) X decreases, Y increases

25. If the reading of ammeter A_3 in figure is 0.75 A. Neglecting the resistance of the ammeters, the reading of ammeter A_2 will be :



(*a*) 1.5 A (*b*) 3 A
(*c*) 4.5 A (*d*) 6 A

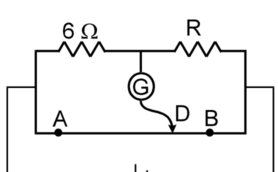
26. The ammeter shown in figure consists of a 480 Ω coil connected in parallel to a 20 Ω shunt. Find the reading of the ammeter.



(*a*) $\frac{50}{73}$ A (*b*) $\frac{40}{53}$ A

(*c*) $\frac{50}{93}$ A (*d*) $\frac{73}{50}$ A

27. The meter-bridge wire AB shown in figure is 50 cm long. When AD = 30 cm, no deflection occurs in the galvanometer. Find R.

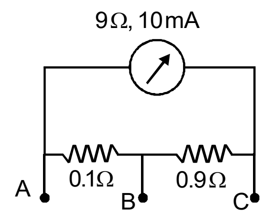


(*a*) 1 Ω (*b*) 2 Ω
(*c*) 3 Ω (*d*) 4 Ω

28. If an ammeter is to be used in place of a voltmeter then we must connect with the ammeter a

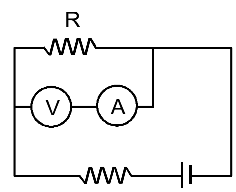
(*a*) Low resistance in parallel
(*b*) High resistance in parallel
(*c*) High resistance in series
(*d*) Low resistance in series

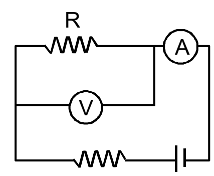
29. A milliammeter of range 10mA and resistance 9Ω is joined in a circuit as shown. The metre gives full-scale deflection for current I when A and B are used as its terminals, i.e., current enters at A and leaves at B (C is left isolated). The value of I is

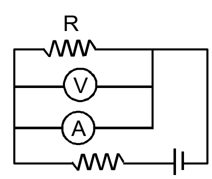


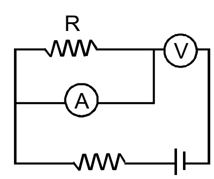
(*a*) 100 mA (*b*) 900 mA
(*c*) 1 A (*d*) 1.1 A

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

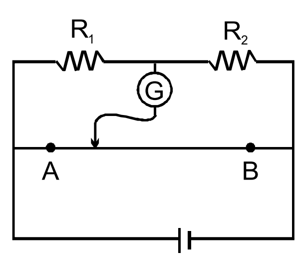
(*a*)


(*b*)


(*c*)


(*d*)


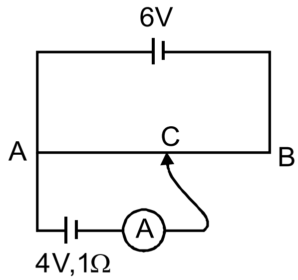
31. In the figure shown for gives values of R_1 and R_2 the balance point for Jockey is at 40 cm from A. When R_2 is shunted by a resistance of 10 Ω, balance shifts to 50 cm. R_1 and R_2 are (AB = 1m)



(*a*) $\frac{10}{3}\Omega, 5\Omega$ (*b*) $20\Omega, 30\Omega$

(*c*) $10\Omega, 15\Omega$ (*d*) $5\Omega, \frac{15}{2}\Omega$

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



(*a*) 2/3 m (*b*) 1/3 m
(*c*) 3/5 m (*d*) 1/2 m

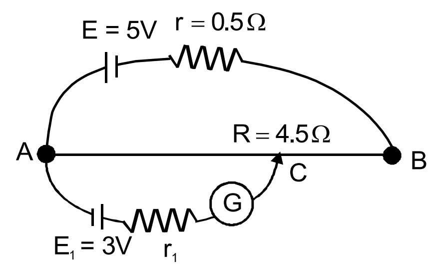
33. A potentiometer wire has length 10 m and resistance 10Ω. It is connected to a battery of EMF 11 volt and internal resistance 1Ω, then the potential gradient in the wire is
(*a*) 10 V/m (*b*) 1 V/m
(*c*) 0.1 V/m (*d*) none

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

(*a*) $\frac{2l}{3}$ (*b*) $\frac{l}{2}$

(*c*) $\frac{l}{6}$ (*d*) $\frac{4l}{3}$

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



(*a*) 2m (*b*) 1.8m
(*c*) dependent on r_1 (*d*) none of these

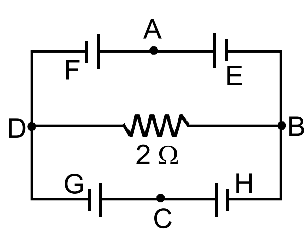
Advanced Level Multiconcept Questions

MCQ/COMPREHENSION/MATCHING/ NUMERICAL

1. A current passes through a wire of non-uniform cross-section. Which of the following quantities are independent of the cross-section?
(*a*) the charge crossing in a given time interval
(*b*) drift speed
(*c*) current density
(*d*) free-electron density.

2. The current density in a wire is 10 A/cm^2 and the electric field in the wire is 5 V/cm. If ρ = resistivity of material, σ = conductivity of the material then (in S.I. units):
(*a*) $\rho = 5 \times 10^{-3}$ (*b*) $\rho = 200$
(*c*) $\sigma = 5 \times 10^{-3}$ (*d*) $\sigma = 200$

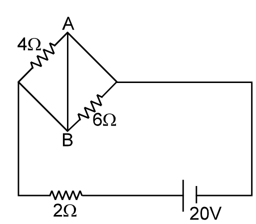
3. In the circuit shown E, F, G and H are cells of e.m.f. 2V, 1V, 3V and 1V respectively and their internal resistances are 2Ω, 1Ω, 3Ω and 1Ω respectively.



(*a*) $V_D - V_B = -2/13$ V
(*b*) $V_D - V_B = 2/13$ V
(*c*) $V_G = 21/13$ V = potential difference across G.
(*d*) $V_H = 19/13$ V = potential difference across H.

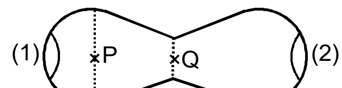
4. A bulb is connected to an ideal battery of emf 10 V so that the resulting current is 10 mA. When the bulb is connected to 220 V mains (ideal), the current is 50 mA. Choose the correct alternative(s)
(*a*) In the first case, the resistance of the bulb is 1kΩ and in second case, it is 4.4 kΩ.
(*b*) 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

5. In the circuit shown in figure



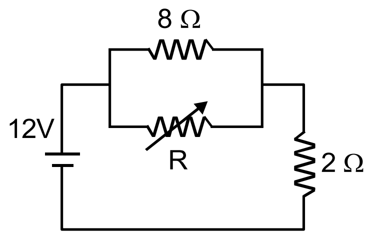
(*a*) power supplied by the battery is 200 watt
(*b*) current flowing in the circuit is 5 A
(*c*) potential difference across 4 Ω resistance is equal to the potential difference across 6Ω resistance
(*d*) current in wire AB is zero

6. A metallic conductor of irregular cross-section is as shown in the figure. A constant potential difference is applied across the ends (*a*)and (*b*). Then :



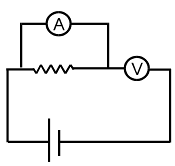
(*a*) the current at the cross-section P equals the current at the cross-section Q
(*b*) the electric field intensity at P is less than that at
(*c*) the rate of heat generated per unit time at Q is greater than that at P
(*d*) the number of electrons crossing per unit area of cross-section at P is less than that at

7. The value of the resistance R in figure is adjusted such that power dissipated in the 2Ω resistor is maximum. Under this condition



(*a*) R = 0
(*b*) R = 8Ω
(*c*) power dissipated in the 2Ω resistor is 72 W
(*d*) power dissipated in the 2Ω resistor is 8 W

8. By mistake, a voltmeter is placed in series and an ammeter in 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.

9. A micro-ammeter has a resistance of 100 Ω and full scale range of 50 μA. It can be used as a voltmeter and an ammeter of a higher range provided a resistance is added to it. Pick the correct range and resistance combination (s):
(*a*) 50 V range with 10 kΩ resistance is series
(*b*) 10 V range with 200 kΩ resistance in series
(*c*) 5 mA range with 1 Ω resistance in parallel
(*d*) 10 mA range with 1 Ω resistance in parallel

10. In a potentiometer arrangement. E_1 is the cell establishing current in primary circuit. E_2 is the cell to be measured. AB is the potentiometer wire and G is a galvanometer. Which of the following are the essential condition for balance to be obtained.
(*a*) The emf of E_1 must be greater than the emf of E_2
(*b*) Either the positive terminals of both E_1 and E_2 or the negative terminals of both E_1 and E_2 must be joined to one end of potentiometer wire.
(*c*) The positive terminals of E_1 and E_2 must be joined to one end of potentiometer wire.
(*d*) The resistance of G must be less than the resistance of AB.

11. Why is high tension wire thick wire. Select the most appropriate option
(*a*) so that more current may flow
(*b*) so that resistance will be less thereby reducing power loss in the transmission line.
(*c*) so that it may bear high tension & therefore sag less.
(*d*) so that when in future population increases, the existing wire may serve the purpose.

12. Consider a bird having effective resistance 10Ω between its feet sitting on this high tension wire. The distance between its feet is 10 cm. The potential difference between the feet of the bird is approximately.
(*a*) 0.1 V (*b*) 1 V
(*c*) 10 V (*d*) 0.05 V

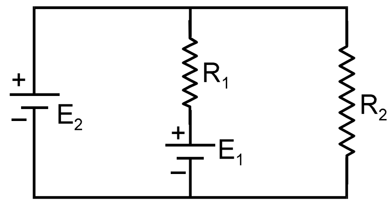
13. In the above question find the current through the bird.
(*a*) 10 A (*b* 1 A
(*c*) 0.01 A (*d*) 0.005 A

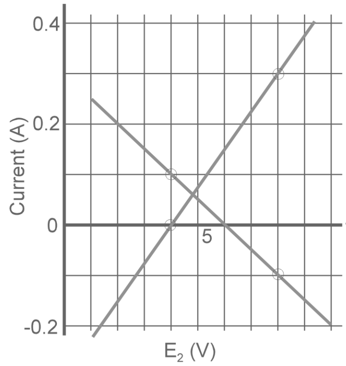
14. In the above question if the potential difference between HT at A and corresponding point on earth wire is 11 kV, find potential difference between point B and corresponding point on earth wire.
(*a*) 1 KV (*b*) 2 KV
(*c*) 9 KV (*d*) 10 KV

15. If the 'Critical Current' for the bird is 0.1 A, find the maximum power at 11 KV that can be transmitted at point A so that the bird may not get shock. Assume that the distance between the feet is 10 cm and the resistance of the bird is 10Ω.
(*a*) 111 KW (*b*) 11 KW
(*c*) 101 KW (*d*) 110011 KW

Comprehension Type Questions-2 (No. 16 to 18)

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





16. The value of emf E_1 is
(*a*) 8V (*b*) 6V
(*c*) 4V (*d*) 2V

17. The resistance R_1 has value
(*a*) 10 Ω (*b*) 20 Ω
(*c*) 30 Ω (*d*) 40 Ω

18. The resistance R_2 is equal to :
(*a*) 10 Ω (*b*) 20 Ω
(*c*) 30 Ω (*d*) 40 Ω

19. Match the following :
The following table gives the lengths of four copper rods at the same temperature, their diameters, and the potential differences between their ends.

Rod	Length	Diameter	Potential Difference
1	L	3d	V
2	2L	d	3V
3	3L	2d	2V
4	3L	d	V

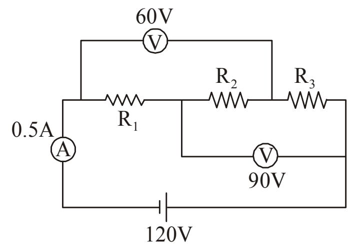
Correctly match the physical quantities mentioned in the left column with the rods as marked.
(*a*) Greatest Drift speed of the electrons. (p) Rod 1
(*b*) Greatest Current (q) Rod 2
(*c*) Greatest rate of thermal energy produced (r) Rod 3
(*d*) Greatest Electric field (s) Rod 4

20. Match the statements in Column I with the current element in Column II.

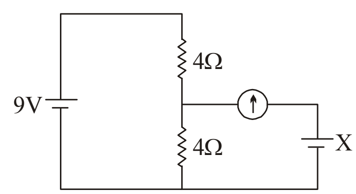
Column - I	Column - II
(*a*) Current always flows from higher potential to lower potential	(p) A Resistor
(*b*) Energy dissipated in an element is always zero	(q) Ideal cell/ Battery
(*c*) Current flow through the element is always zero	(r) Non-Ideal cell/ Battery
(*d*) Potential difference may be zero	(s) Short-circuited resistor

NUMERICAL VALUE BASED

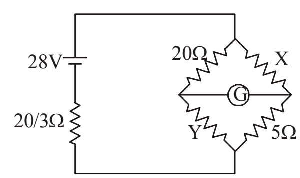
21. In the circuit shown, all voltmeters & ammeter are ideal. The internal resistance of battery is 20Ω. The readings of voltmeter and ammeter are marked in the figure. What is resistance R_2 (in ohm)?



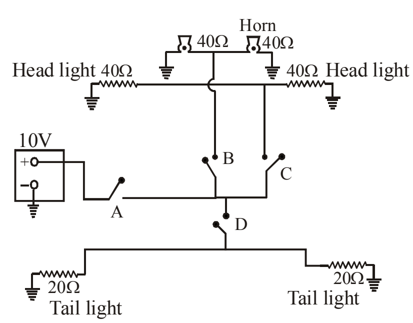
22. If each battery in figure has internal resistance of 1Ω, what should be the e.m.f. of X (in V) for there to be no deflection on the galvanometer?



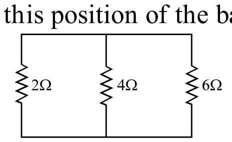
23. In the balanced wheatstone bridge arrangement, the current drawn from the battery is 1.4A. Find resistance X in Ω.



24. Figure shows an automobile circuit. How much power (in watt)is dissipated by the automobile circuit when switches A, B, C and D are all closed.



25. In one of the branches of the circuit shown in figure a 11V battery is to be inserted so that it dissipates minimum power. What will be current (in Ampere) through the 2Ω resistance for this position of the battery?



Topicwise Questions

1. (*b*) $I = neAv_d$

2. (*b*) Order of drift velocity $= 10^{-4}$ m/sec $= 10^{-2}$ cm/sec

3. (*b*) Density of Cu $= 9 \times 10^3$ kg/m^3 (mass of 1 m^3 of Cu)

$\because$ 6.0×10^{23} atoms has a mass $= 63 \times 10^{-3}$ *kg*

$\therefore$ Number of electrons per m^3 are

$$= \frac{6.0\times10^{23}}{63\times10^{-3}} \times 9 \times 10^3 = 8.5 \times 10^{28}$$

Now drift velocity $= v_d = \dfrac{i}{neA}$

$$= \frac{1.1}{8.5\times10^{28}\times1.6\times10^{-19}\times\pi\times(0.5\times10^{-3})^2}$$

$= 0.1 \times 10^{-3}$ m/sec

4. (*a*) $v_d = \dfrac{e}{m}\times\dfrac{V}{l}\tau$ or $v_d = \dfrac{e}{m}\cdot\dfrac{El}{l}\tau$ (Since $V = El$)

$\therefore$ $v_d \propto E$

5. (*b*) $R \propto \dfrac{1}{A} \Rightarrow R \propto \dfrac{1}{A} \propto \dfrac{1}{d^2}$

[*d* = diameter of wire]

6. (*b*) In the absence of external electric field mean velocity of free electron (V_{rms}) is given by $V_{rms} = \sqrt{\dfrac{3KT}{m}}$

$\Rightarrow V_{rms} \propto \sqrt{T}$.

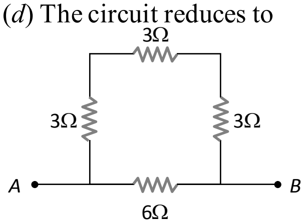
7. (*a*) $\dfrac{R_1}{R_2} = \left(\dfrac{r_2}{r_1}\right)^4 \Rightarrow \dfrac{R}{R_2} = \left(\dfrac{nr}{r}\right)^4 \Rightarrow R_2 = \dfrac{R}{n^4}$.

8. (*d*) $R = 91 \times 10^2 \approx 9.1\ k\Omega$.

9. (*b*) Resistance of parallel group $= \dfrac{R}{2}$

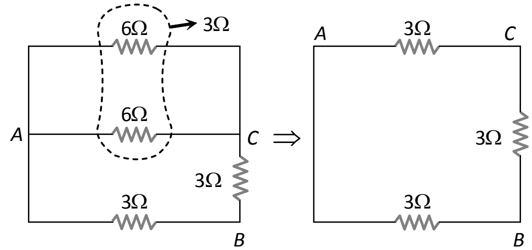
$\therefore$ Total equivalent resistance $= 4 \times \dfrac{R}{2} = 2R$.

10. (*d*) The circuit reduces to



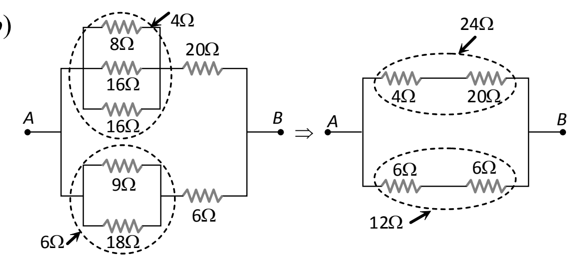
$$R_{AB} = \frac{9\times6}{9+6} = \frac{9\times6}{15} = \frac{18}{5} = 3.6\,\Omega$$

11. (*b*) Given circuit is equivalent to



So the equivalent resistance between points *A* and *B* is equal to $R = \dfrac{6\times3}{6+3} = 2\Omega$.

12. (*b*)



$$R_{AB} = \frac{24\times12}{(24+12)} = 8\Omega$$

13. (*d*) Three resistances are in parallel.

$$\therefore \quad \frac{1}{R'} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} = \frac{3}{R}$$

The equivalent resistance $R' = \dfrac{R}{3}\,\Omega$.

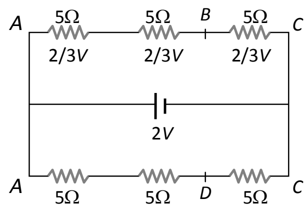
14. (*c*)

15. (*a*) $R_1 = \dfrac{\rho_1 l_1}{A}$ and $R_2 = \dfrac{\rho_2 l_2}{A}$.

In series $R_{eq} = R_1 + R_2$

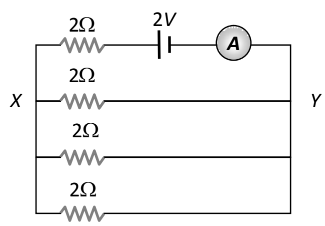
$$\frac{\rho_{eq.}(l_1+l_2)}{A} = \frac{\rho_1 l_1}{A} + \frac{\rho_2 l_2}{A} \Rightarrow \rho_{eq} = \frac{\rho_1 l_1 + \rho_2 l_2}{l_1 + l_2}.$$

16. (*c*) The given circuit can be redrawn as follows



For identical resistances, potential difference distributes equally among all. Hence potential difference across each resistance is $\frac{2}{3}$V and potential difference between A and B is $\frac{4}{3}$V.

17. (*b*) Resistance across XY $= \frac{2}{3}\Omega$



Total resistance

$$= 2 + \frac{2}{3} + \frac{8}{3}\Omega$$

Current through ammeter $= \frac{2}{8/3} = \frac{6}{8} = \frac{3}{4}$A

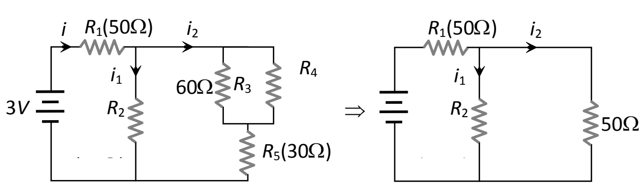
18. (*b*) Current in the given circuit $i = \frac{50}{(5+7+10+3)} = 2A$

Potential difference between A and B $V_A - V_B = 2 \times 12$

$\Rightarrow V_A - 0 = 24V \Rightarrow V_A = 24V.$

19. (*c*) Given circuit is a balanced Wheatstone bridge i.e. potential difference between *B* and *D* is zero. Hence, no current flows between *B* and *D*.

20. (*a*) Equivalent resistance of the given network $R_{eq} = 75\,\Omega$.



21. (*b*) For no current through galvanometer, we have

$$\left(\frac{E_1}{500+X}\right)X = E \Rightarrow \left(\frac{12}{500+X}\right)X = 2 \Rightarrow X = 100\,\Omega.$$

22. (*a*) Applying Kirchhoff law

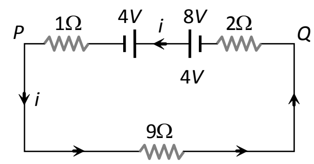
$$(2+2) = (0.1+0.3+0.2)i \Rightarrow i = \frac{20}{3}A$$

Hence potential difference across *A*

$$= 2 - 0.1 \times \frac{20}{3} = \frac{4}{3}V \text{ (less than 2V).}$$

and similarly across B will be zero.

23. (*a*) Applying Kirchoff's voltage law in the given loop.



$$-2i + 8 - 4 - 1 \times 9i = 0 \quad -2i + 8 - 4 - 1 \times i - 9i = 0$$

$$\Rightarrow i = \frac{1}{3}A$$

Potential difference across PQ $= \frac{1}{3} \times 9 = 3V$.

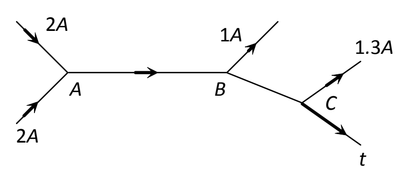
24. (*a*) Given problem is the case of mixed grouping of cells

So total current produced $i = \dfrac{nE}{R + \dfrac{nr}{m}}$

Here $m = 100, n = 5000, R = 500\,\Omega$
$E = 0.15$ V and $r = 0.25\Omega$

$$\Rightarrow i = \frac{5000 \times 0.15}{500 + \dfrac{5000 \times 0.25}{100}} = \frac{750}{512.5} \approx 1.5A.$$

25. (*a*) According to Kirchhoff's first law
At junction A, $i_{AB} = 2 + 2 = 4A$
At junction B,



At junction C, $i = i_{BC} - 1.3 = 3 - 1.3 = 1.7$ amp.

26. (*d*) Zero (No potential difference across voltmeter).

27. (*c*) Reading of voltmeter

$$= E_{eq} = \frac{E_1 r_2 + E_2 r_1}{r_1 + r_2} = \frac{18 \times 1 + 12 \times 2}{1+2} = 14V.$$

28. (*a*) In meter bridge experiment, it is assumed that the resistance of the L shaped plate is negligible, but actually it is not so. The error created due to this is called, end error. To remove this the resistance box and the unknown resistance must be interchanged and then the mean reading must be taken.

29. (*c*) To convert a galvanometer into an ammeter a low value resistance is to be connected in parallel to it called shunt.

30. (*a*) Potential gradient $= \dfrac{e}{(R+R_h+r)} \cdot \dfrac{R}{L}$

$$= \frac{2}{(15+5+0)} \times \frac{5}{1} = 0.5\frac{V}{m} = 0.005\frac{V}{cm}.$$

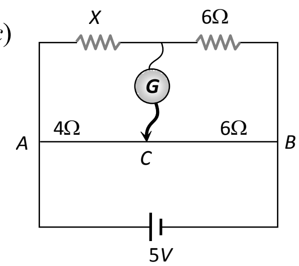
31. (*d*) By using $R = \dfrac{V}{i_g} - G$

$$\Rightarrow R = \frac{100}{5\times10^{-3}} - 5 = 19{,}995\Omega$$

32. (*c*) By Wheatstone bridge, $\dfrac{R}{80} = \dfrac{AC}{BC} = \dfrac{20}{80} \Rightarrow R = 20\Omega.$

33. (*a*) $E \propto l$ (balancing length)

34. (*c*)



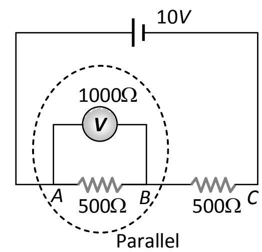
Resistance of the part AC

$R_{AC} = 0.1\times40 = 4\Omega$ and $R_{CB} = 0.1\times60 = 6\Omega$

In balanced condition $\dfrac{X}{6} = \dfrac{4}{6} \Rightarrow X = 4\Omega$

Equivalent resistance $R_{eq} = 5\Omega$ so current drawn from battery $i = \dfrac{5}{5} = 1A.$

35. (*d*) Resistance between A and B $= \dfrac{1000\times500}{(1500)} = \dfrac{1000}{3}$



So, equivalent resistance of the circuit

$$R_{eq} = 500 + \frac{1000}{3} = \frac{2500}{3}$$

∴ Current drawn from the cell

$$i = \frac{10}{(2500/3)} = \frac{3}{250}A$$

Reading of voltmeter i.e.
potential difference across 500Ω resistor is 4V.

Learning Plus

1. (*d*) In the presence of an applied electric field ($\vec{E}$) in a metallic conductor. The electrons also move randomly but slowly drift in a direction opposite to $\vec{E}$.

2. (*c*) Given that $v_{d_1} = v,\ v_{d_2} = ?$

We know that
$I = neAv_d$

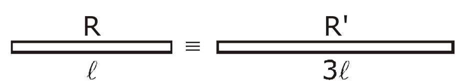
$$\Rightarrow \quad V_d \propto \frac{1}{A} \propto \frac{1}{\frac{\pi d^2}{4}} \propto \frac{1}{d^2}$$

$$\frac{V_{d_1}}{V_{d_2}} = \frac{(d/2)^2}{d^2} = \frac{1}{4}$$

$V_{d_2} = 4V$

3. (*c*) $j = \dfrac{i}{A}$ current density inversely proportional to area of cross section

4. (*d*)



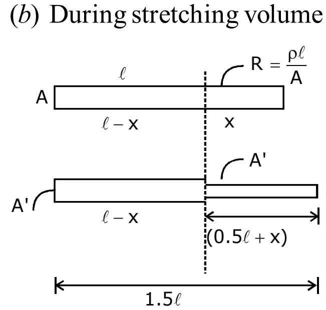
During stretching volume is constant
$Al = A'(3l)$

$\Rightarrow A' = A/3$

$$\frac{R'}{R} = \frac{\rho\, 3\ell}{A' \frac{\rho\ell}{A}},\quad R' = \frac{3A}{A'}\times R$$

Put A' and R from above $R' = R_{new} = 9R = 180\Omega$

5. (*b*) During stretching volume remains constant



R'= 4R

$Ax = A'(0.5\ell + x)$

$$A' = \frac{Ax}{0.5\ell + x} \qquad ....(1)$$

$$\Rightarrow \frac{4\rho\ell}{A} = \frac{\rho(\ell - x)}{A} + \frac{\rho(0.5\ell + x)}{A'} \quad ....(2)$$

Put value of A' in equation (2) from equation (1)

$$\Rightarrow \frac{4\rho\ell}{A} = \frac{\rho(\ell - x)}{A} + \frac{\rho(0.5\ell + x)^2}{Ax}$$

$\Rightarrow 4\ell x = \ell x - x^2 + (0.5\ell)^2 + \ell x + x^2$

After solving $x = (1/8)\ell$

6. (*d*) We know that $R = \dfrac{\rho l}{A}$

$$\left.\begin{aligned} x &= \frac{\rho 4a}{2a^2} = \frac{2\rho}{a} \\ y &= \frac{\rho a}{8a^2} = \frac{\rho}{8a} \\ z &= \frac{\rho(2a)}{4a^2} = \frac{\rho}{2a} \end{aligned}\right\} \text{From } R = \frac{\rho\ell}{A}$$

$x > z > y$

7. (*c*) Given that $v_d' = 2v_d$
$I = neAv_d$, $A = \pi r^2$

$$I' = neA'v_d', A' = \frac{\pi r^2}{4}$$

$$I' = ne\frac{\pi r^2}{4} v_d'$$

$$I' = ne\frac{\pi r^2}{4}.2V_d$$

$I' = I/2$

8. (*b*) $R_1 = R_{01}(1 + \alpha_1 \Delta\theta) = 600(1 + 0.001 \times 30) = 618\,\Omega$
$R_2 = R_{02}(1 + \alpha_2 \Delta\theta) = 300(1 + 0.004 \times 30) = 336\,\Omega$
$R_{eq} = R_1 + R_2 = 618 + 336 = 954\,\Omega$

9. (*c*) $R_{eq} = R_{0eq}(1 + \alpha_{eq}\,\Delta\theta)$ $954 = 900(1 + \alpha\, 30)$ $\alpha =$

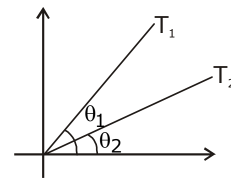
$$\frac{54}{900 \times 30} = \frac{1}{500} \text{ degree}^{-1}$$

10. (*b*) we no that $I = neAv_d$

$$V_d = \frac{I}{neA} \propto \frac{I}{r^2}$$

$$\frac{V_{d_1}}{V_{d_2}} = \left(\frac{I_1}{I_2}\right)\left(\frac{r_2}{r_1}\right)^2 = \left(\frac{4}{1}\right)\left(\frac{2}{1}\right)^2 = 16$$

11. (*b*) $R = \dfrac{V}{I} \Rightarrow \dfrac{I}{V} = \dfrac{1}{R}$

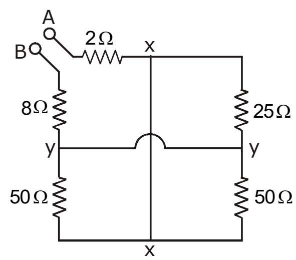


$\because\ \theta_1 > \theta_2$
$\Rightarrow R_1 < R_2 \Rightarrow T_1 < T_2$

$\because\ T\uparrow R\uparrow$

12. (*c*) $i = neAV_d$
i is same so
$A\uparrow V_d\downarrow$

13. (*b*)



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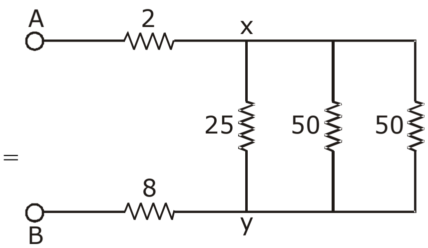
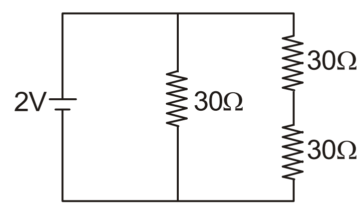


$$R_{eq.} = 2 + \frac{25}{2} + 8 = \frac{45}{2}\Omega$$

14. (*c*) This simplified circuit is shown in the figure.



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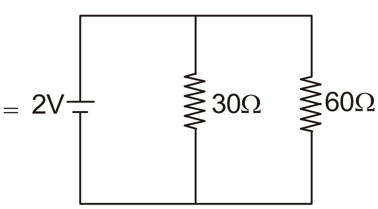

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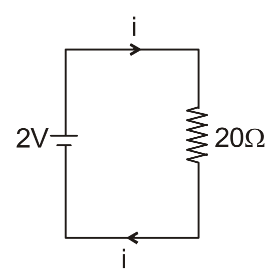


Therefore, current $i = \dfrac{2}{20} = \dfrac{1}{10}$ A

15. (*d*) All resistances are parallel so potential is same
$V = 0.3 \times 20 = 6V$

$$i_1 : i_1 : i_3 = \frac{1}{R_1} : \frac{1}{20} : \frac{1}{15}$$
$$= 60 : 3R_1 : 4R_1$$
$$\Rightarrow \; 0.3 = \frac{3R_1}{60 + 7R_1} \times (0.8)$$
$$\Rightarrow \; R_1 = 60\,\Omega$$

16. (1) $R_{eq} = 2 + \frac{4}{2} + \frac{15}{3} + R_A = 9 + R_A$

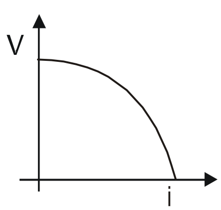
$$I = \frac{V}{R_{eq}} \Rightarrow 1 = \frac{10}{9 + R_A} \Rightarrow R_A = 1\Omega$$

if 4Ω replace by 2Ω resistance then

$$R_{eq} = 2 + \frac{2}{2} + \frac{15}{3} + 1 = 9\Omega$$

$$I = \frac{10}{9} \text{ amp}$$

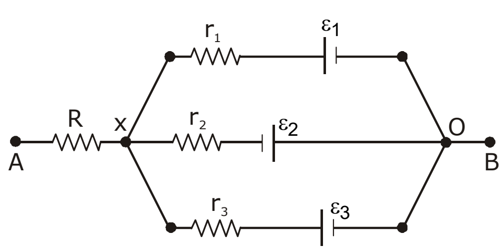
17. (*d*) Given $r \propto i \Rightarrow r = ki$
$V = E - ir = E - i(ki)$
$V = -i^2 k + E$



18. (*b*) (a) $V = E - ir, V < E$
(b) $V = E + ir, V > E$
(c) $V = E$
(d) $V = E$

19. (*c*) $E + ir = 12.5$ Volt
$E + (0.5 \times 1) = 12.5$
$E = 12$ volt

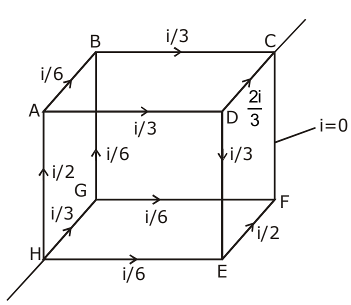
20. (*b*)



$$\frac{x - \varepsilon_1}{r_1} + \frac{x - \varepsilon_2}{r_2} + \frac{x - \varepsilon_3}{r_3} = 0$$

$x = 2$ volt

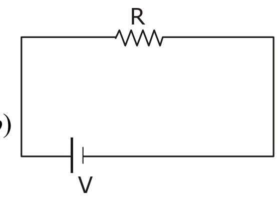
21. (*b*)



22. (*a*) $R_{2.5\,W} = \frac{(110)^2}{2.5}\ \Omega$, $R_{100W} = \frac{(110)^2}{100} \;\Rightarrow R_{2.5} > R_{100}$.

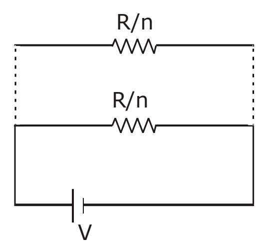
In series current passes through both bulb are same
$P_{2.5} = i^2 R_{2.5}, P_{100} = i^2 R_{100}$
$P_{2.5} > P_{100}$ due to $R_{2.5} > R_{100}$ & $\because P_{2.5} > 2.5W$ & $P_{100} < 100$ W (can be verified)
Therefore 2.5 W bulb will fuse

23. (*b*)



Initially $H = \frac{v^2}{R}$

Now after cutting

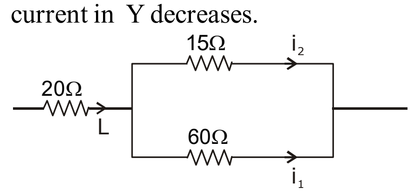


$$\text{Power in one branch} = \frac{V^2}{R/n} = \frac{nV^2}{R}$$

$$\text{Total power} = \frac{nV^2}{R} + \frac{nV^2}{R} + \ldots = \frac{n^2V^2}{R}$$

24. (*b*) As R_{eq} decreases I_{net} increases hence current through X increases but as I_{net} will now be distributed in Y & Z, current in Y decreases.

25. (*b*)



$$\text{Given } \frac{15 \times i}{75} = 0.75$$

$$\text{Now } i_2 = \frac{60 \times i}{75} = \left[\frac{60 \times 0.75 \times 75}{15}\right] = 3A$$

26. (1) $R_{eq} = 10 + \frac{480 \times 20}{480 + 20} = 10 + \frac{96}{5} = \frac{146}{5}$

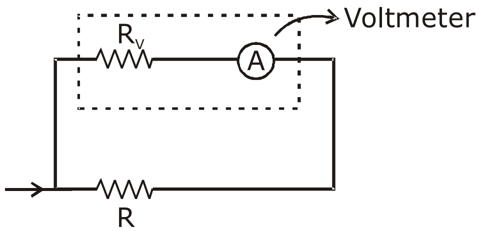
current passes through the battery.

$$I = \frac{20 \times 5}{146} = \frac{100}{146} = \frac{50}{73} \text{ amp.}$$

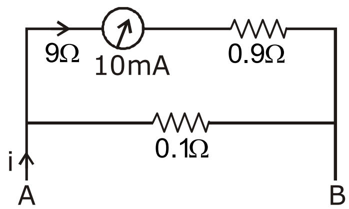
27. (*d*) $\frac{6}{R} = \frac{\ell}{x-\ell}$

$\frac{6}{R} = \frac{30}{20} \Rightarrow R = 4\Omega$

28. (*c*) High resistance in series



29. (*c*) Given for ammeter $i = 10^{-3}$A, $R = 9\Omega$
for given condition circuit shown like



$10 \times 10^{-3} = \frac{0.1}{10} \times i \Rightarrow i = 1$ Ampere

30. (*b*) Voltmeter must be connected in parallel and Ammeter in series with the resistance in circuit.

31. (*a*) $R_1 \times 60 = R_2 \times 40$ ....(1)

$R_1 \times 50 = \frac{R_2 \times 10}{R_2 + 10} \times 50$....(2)

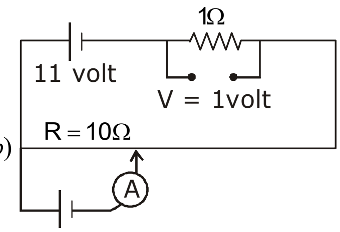
Devide (2) by (1) $\frac{50R_1}{60R_1} = \frac{\frac{10R_2 \times 50}{R_2+10}}{R_2 \times 40}$

$R_2 = 5\Omega$, $R_1 = \frac{10\,\Omega}{3}$

32. (*a*) Potential gradient $x = \frac{6}{1}$

$6\ell = 4 \Rightarrow \ell = \frac{2}{3}$ m

33. (*b*)

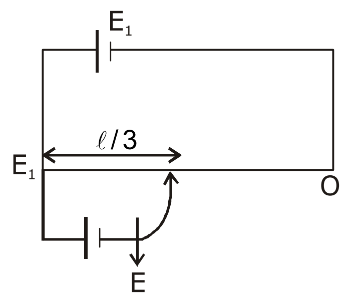


$I = \frac{V}{r+R}$

$I = \frac{11}{10+1} = 1$ Amp,

Potential gradient $= x = \frac{11-1}{10} = \frac{1 \text{ volt}}{m}$

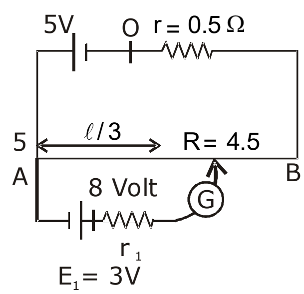
34. (*b*)



$E_1 = 3E$

$1.5\ell \to 3E$, $E \to \frac{\ell}{2}$

35. (*d*)



As Battery is connected in reverse order E_1 will not be balanced on entire length of wire AB.

Advanced Level Multiconcept Questions

1. (*a,d*) In series current remain same $I = neAv_d$, $J = I/A$, for constant current

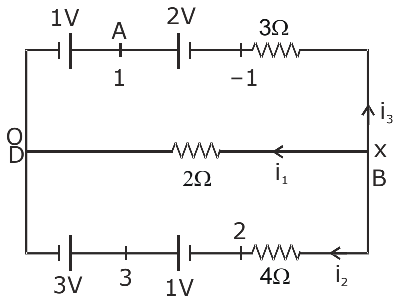
$v_d \propto \frac{1}{A}$ and $J \propto \frac{1}{A}$.

2. (*a,d*) $IR = V = E\ell \Rightarrow I\frac{\rho\ell}{A} = E\ell \Rightarrow \rho = \frac{EA}{I} = \frac{E}{J} =$

$\frac{5 \times 10^{-2}}{10} = 5 \times 10^{-3}\ \Omega$–m

$\sigma = \frac{1}{\rho} = \frac{1}{5 \times 10^{-3}} = 200$ mho/m.

3. (*a,c,d*) In parallel resistance ↓ ∴ i ↑



Let potention of point B is x then from kirchhoff's first law

$i_1+i_2+i_3=0$

$$\frac{x}{2}+\frac{x-2}{4}+\frac{x+1}{3}=0$$

$$\frac{6x+3x-6+4x+4}{12}=0$$

$\Rightarrow$ $13x=2$

$$x=\frac{2}{13}\text{ volt}$$

4. (*a,c*) (i) $R_{bulb}=\frac{V}{I}=\frac{10}{10\times10^{-3}}=1.\text{ k}\Omega$

(ii) $R_{bulb}=\frac{220}{50\times10^{-3}}=4.4\text{ k}\Omega.$

since increase in temperature increases resistance when it is connected to 220 V mains.

5. (*a,c*)

current flow in circuit is I = 10 amp

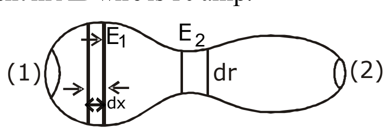
power supplied by the battery is

$=I^2R=(10)^2\times2=200$ W

Potential drop across 4Ω & 6Ω are equal and it is equal to zero.

current in AB wire is 10 amp.

6. (*a,b,c,d*)



$i=neAV_d,\ R=\frac{\rho l}{A}$

$$E_1=\frac{V}{dx}\Rightarrow=\frac{i.R}{dx}=\frac{i.\rho.dx}{A.dx}$$

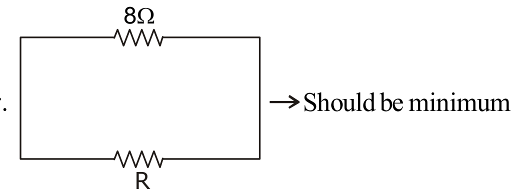
$$\frac{i.\rho}{A}=\text{constant}\Rightarrow E_1\propto\frac{1}{A_1}$$

$$\frac{E_1}{E_2}=\frac{A_2}{A_1}$$

$$P=i^2R\Rightarrow i^2\frac{\rho dx}{A}$$

7. (*a,c*) Current should be maximum in 2Ω

∴



$\Rightarrow$ R = 0 (power should be maximum when r = 0)

Power = 72 watt.

8. (*a,c,d*) For non ideal ammeter and voltmeter, ammeter have low resistance and voltmeter have high resistance. Therefore the main current in the circuit will be very low and almost all current will flow through the ammeter. It emf of cell is very high then current in ammeter is very high result of this current the devices may get damaged. If devices are ideal that means resistance of voltmeter is infinity. so that current in the circuit is zero. Therefore ammeter will read zero reading and voltmeter will read the emf of cell.

9. (*b,c*) for 50 V, $R_V=\frac{50}{50\times10^{-6}}=1000\text{ K}\Omega$ in series

for 10 V, $R_V=\frac{10}{50\times10^{-6}}=200\text{ K}\Omega$ in series

for 5 mA, $R_s=\frac{100\times50\times10^{-6}}{5\times10^{-3}}=1\Omega$ in parallel

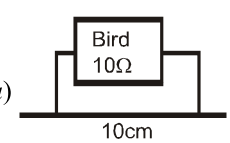
for 10 mA, $R_s=\frac{100\times50\times10^{-6}}{10\times10^{-3}}=\frac{1}{2}\Omega$ in parallel

10. (*a,b*) As emf of E_1 is distributed over the wire AB. Hence A is correct E_2 is balanced by fraction of length of wire $E_1>E_2$.

We only balance potential difference hence B is correct.

11. (*b*)

12. (*a*)

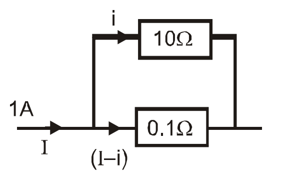


$$r=\left(\frac{1\Omega}{m}\right)(10\text{ cm})\ r=0.1\ \Omega$$

$V_{bird}=(R_{\text{II combination}})$ current

$$V_{bird}=\left(\frac{10\times0.1}{10+0.1}\right)(1)\cong0.1\text{ V}$$

13. (*c*)

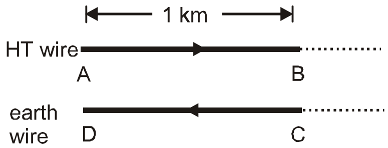


Here $i\times10=(I-i)(0.1)\Rightarrow100i=I-i\Rightarrow101i=I$

If I = 1A

$$i=\frac{1}{101}\text{ A}\cong0.01\text{ A}$$

14. (*c*)



$V_{AD} = 11\text{ KV}, \qquad V_{BC} = ?$

$V_{AD} = V_{AB} + V_{BC} + V_{CD}$

$V_{AB} = IR = (1\text{ A})(1\text{ km} \times 1\Omega/\text{m}) = 1000\text{ V}$

$V_{CD} = V_{AB} = 1000\text{ V}$

$V_{BC} = V_{AD} - V_{AB} - V_{CD} = 11000 - 1000 - 1000.$

$V_{BC} = 9000\text{ Volt}$

15. (*a*) If critical current through bird is 0.1A then main current

$I = 101\ i$ (As Q.No.5)

$I = 101 \times 0.1 = 10.1\text{ A}$

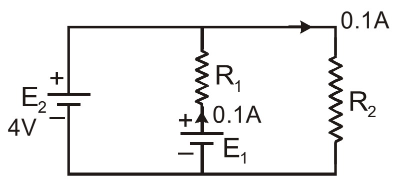
$P_{max} = (11\text{ KV})(10.1\text{ A}) = 111\text{ KW}$

16. (*b*) **17.** (b) **18.** (d)

(19 - 21)

As E_2 is increasing it's current also increases, So, increasing graph is of i_2.

$i_1 = 0.1\text{A}, E_2 = 4\text{V}, i_2 = 0$

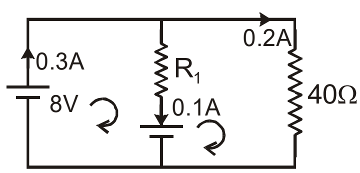


As ;

$0.1\ R_1 + 0.1\ R_2 - E_1 = 0$

$0.1\ R_2 - 4\text{ V} = 0$

$R_2 = 40\ \Omega$



Now; $i_2 = 0.3\text{A}, i_1 = -0.1\text{ A}, E_2 = 8\text{V}$

Now ; $0.1\ R_1 + E_1 - 8 = 0$

When $E_2 = 6\text{V}$, current in E_1 is $i_1 = 0$ (from graph)

$E_1 = 6\text{V}$

$\Rightarrow R_1 = \dfrac{4}{0.2} = 20\ \Omega$

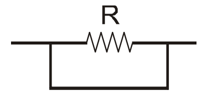
19. (A) q, (B) p, (C) p, (D) q

Drift speed $V_d = \dfrac{J}{ne} = \dfrac{i}{neA}$

$i = \dfrac{V}{R}$ where $R = \dfrac{\rho L}{A}$

$E = \dfrac{V}{L}$ and $P = I^2R$

20. (A) p; (B) q, s; (C) s; (D) p, r, s



short circuited resistor.

In a resistor current always flows from higher potential to lower potential.

In short circuited resistor or ideal cell, energy dissipated is always zero because in short circuited resistor no current flow and in ideal cell has no internal resistance.

Potential difference may be zero across a resistor, non-ideal cell or short circuited resistor.

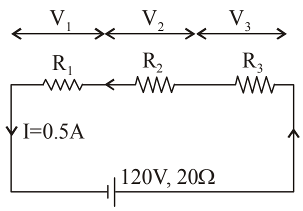
21. [0080]

$V_1 + V_2 + V_3 = 120 - 20\,(0.5)$

$\Rightarrow V_1 + V_2 + V_3 = 110\text{ V} \ldots (1)$

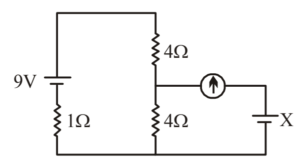
Also $V_1 + V_2 = 60 \Rightarrow V_3 = 110 - 60 = 50\text{V}$

Now $V_2 + V_3 = 90 \Rightarrow V_2 = 40\text{V}$



$\therefore R_2 = \dfrac{40}{0.5} = 80\Omega$

22. [0004]



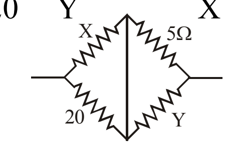
x = P.d. across $4\Omega = 4\text{V}$

23. [25]

As bridge is balanced, $\dfrac{x}{20} = \dfrac{5}{Y}$ or $Y = \dfrac{100}{X}$

and Pea of

should be $\dfrac{40}{3}\Omega$



Making equation and solving we get $X = 25\Omega$

24. [0020] All the elements of circuit are in parallel arrangement

$$\frac{1}{R_{eq}} = \frac{1}{40} \times \frac{1}{40} \times \frac{1}{40} \times \frac{1}{40} \times \frac{1}{20} \times \frac{1}{20} = \frac{4}{40} \times \frac{2}{40}$$

$R_{eq} = 5\Omega$

Power $= V^2/R = 20$ W

25. [0001]

More the resistance less will be power dissipated.

$\therefore$ One should connecte the battery is 6Ω resistor.