PHYSICS

BOOKS - U-LIKE PHYSICS (HINGLISH)

CURRENT ELECTRICITY

Ncert Textbook Exercises

1. The storage battery of a car has an emf of 12

V. If the internal resistance of the battery is 0.4

Ω, what is the maximum current that can be drawn from the battery ?

View Text Solution

2. A battery of emf 10 V and internal resistance 3Ω is connected to a resistor. If the current in the circuit is 0.5 A, what is the resistance of the resistor ? What is the terminal voltage of the battery when the circuit is closed ?

View Text Solution

3. Three resistors $1\Omega, 2\Omega$ and 3Ω are combined in series. What is the total resistance of the combination ?

(b) If the combination is connected to a battery of emf 12 V and negligible internal resistance, obtain the potential drop across each resistor.

View Text Solution

4. (a) Three resistors $2\Omega, 4\Omega$ and 5Ω are combined in parallel. What is the total

resistance of the combination ?

(b) If the combination is connected to a battery of emf 20 V and negligible internal resistance, determine the current through each resistor, and the total current drawn from the battery.

View Text Solution

5. At room temperature $(27.0^{\circ}C)$ the resistance of a heating element is 100Ω . What is the temperature of the element if the

resistance is found to be 117Ω, given that the temperature coefficient of the material of the resistor is $1.70 \times 10^{-4} \circ C^{-1}$?

View Text Solution

6. A negligibly small current is passed through a wire of length 15 m and uniform cross-section $6.0 \times 10^{-7} m^2$, and its resistance is measured to be 5.0 Ω. What is the resistivity of the material at the temperature of the experiment ?

View Text Solution

7. A silver wire has a resistance of 2.1 Ω at $27.5^{\circ}C$, and a resistance of 2.7 Ω at $100^{\circ}C$. Determine the temperature coefficient of resistivity of silver.

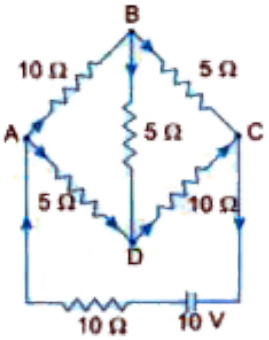
View Text Solution

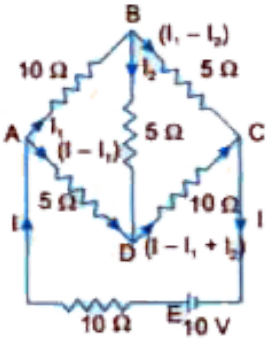
8. A heating element using nichrome connected to a 230 V supply draws an initial current of 3.2 A which settles after a few

seconds to a steady value of 2.8 A. What is the steady temperature of the heating element if the room temperature is $27.0^{\circ}C$? Temperature coefficient of resistance of nichrome averaged over the temperature range involved is $1.70 \times 10^{-4 \circ} C^{-1}$.

View Text Solution

9. Determine the current in each branch of the network shown in Fig.



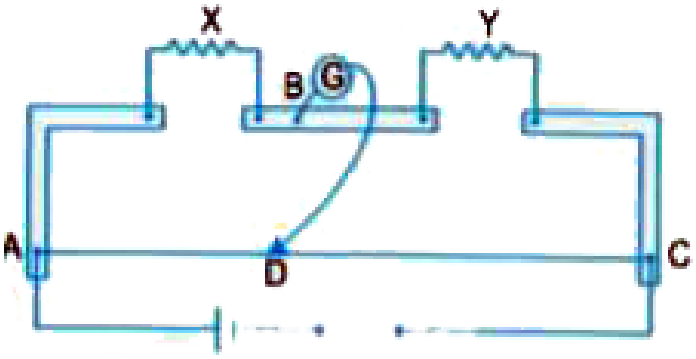


View Text Solution

10. (a) In a metre bridge the balance point is found to be at 39.5 cm from the end A, when the resistor Y is of 12.5 Ω . Determine the resistance of X. Why are the connections between resistors in a Wheatstone or metre bridge made of thick copper strips ?

(b) Determine the balance point of the bridge above if X and Y are interchanged.

(c) What happens if the galvanometer and cell are interchanged at the balance point of the bridge? Would the galvanometer show any current ?



View Text Solution

11. A storage battery of emf 8.0 V and internal resistance 0.5 Ω is being charged by a 120 Ω d.c. supply using a series resistor of 15.5 Ω . What is the terminal voltage of the battery during charging ? What is the purpose of having a series resistor in the charging circuit ?

View Text Solution

12. In a potentiometer arrangement, a cell of emf 1.25 V gives a balance point at 35.0 cm length of the wire. If the cell is replaced by another cell and the balance point shifts to 63.0 cm, what is the emf of the second cell ?

View Text Solution

13. The number density of free electrons in a copper conductor as estimated is $8.5 \times 10^{28} m^{-3}$. How long does an electron

take to drift from one end of a wire 3.0 m long to its other end ? The area of cross-section of the wire is $2.0 \times 10^{-6} m^2$ and it is carrying a current of 3.0 A.

View Text Solution

Additional Exercises

1. (a) Six lead-acid type of secondary cells each of emf 2.0 V and internal resistance 0.015 Ω are joined in series to provide a supply to a

resistance of 8.5 Ω. What are the current drawn from the supply and its terminal voltage ?

(b) A secondary cell after long use has an emf of 1.9 V and a large internal resistance of 380 Ω . What maximum current can be drawn from the cell ? Could the cell drive the starting motor of a car?

View Text Solution

2. Two wires of equal length, one of aluminium and the other of copper have the same resistance. Which of the two wires is lighter ? Hence, explain why aluminium wires are preferred for overhead power cables.

(

$\rho_{Al} = 2.63 \times 10^{-8} \Omega m, \rho_{Cu} = 1.72 \times 10^{-8} m$

, relative density of Al = 2.7 , of Cu = 8.9)

View Text Solution

3. What conclusion can you draw from the following observations on a resistor made of alloy manganin ?

Current (A)	Voltage (V)	Current (A)	Voltage (V)
0.2	3.94	3.0	59.2
0.4	7.87	4.0	78.8
0.6	11.8	5.0	98.6
0.8	15.7	6.0	118.5
1.0	19.7	7.0	138.2
2.0	39.4	8.0	158.0

View Text Solution

4. A steady current flows in a metallic conductor of non-uniform cross-section. Which of these quantities is constant along

the conductor: current, current density, electric field, drift speed ?

View Text Solution

5. Is Ohm's law universally applicable for all conducting elements? If not, give examples of elements which do not obey Ohm's law.

View Text Solution

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

View Text Solution

7. A high tension (HT) supply of, say, 6 kV must have a very large internal resistance. Why?

View Text Solution

8. Choose the correct alternative :

(a) Alloys of metals usually have (greater/less) resistivity than that of their constituent metals.

(b) Alloys usually have much (lower/higher) temperature coefficients of resistance than pure metals.

(c) The resistivity of the alloy manganin is nearly independent of increases rapidly with increase of temperature.

(d) The resistivity of a typical insulator (e.g.,

amber) is greater than that of a metal by a factor of the order of $\left(\frac{10^{22}}{10^{3}}\right)$.

View Text Solution

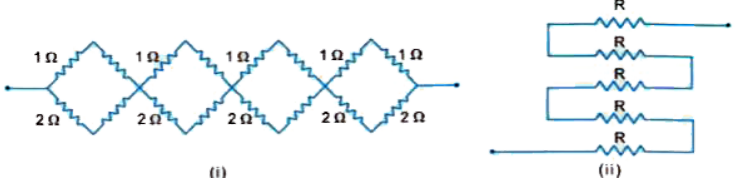
9. Given n resistors each of resistance R, how will you combine them to get the (i) maximum (ii) minimum effective resistance ? What is the ratio of the maximum to minimum resistance ?

View Text Solution

10. Given the resistances of $1\Omega, 2\Omega, 3\Omega$ how will we combine them to get an equivalent resistance of (i) $\left(\frac{11}{3}\right)\Omega, (ii)\left(\frac{11}{5}\right)\Omega, (iii)6\Omega, (iv)\left(\frac{6}{11}\right)\Omega$?

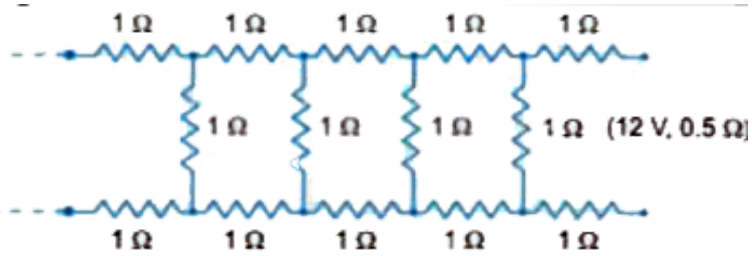
View Text Solution

11. Determine the equivalent resistance of networks shown in Fig. (i) and (ii).

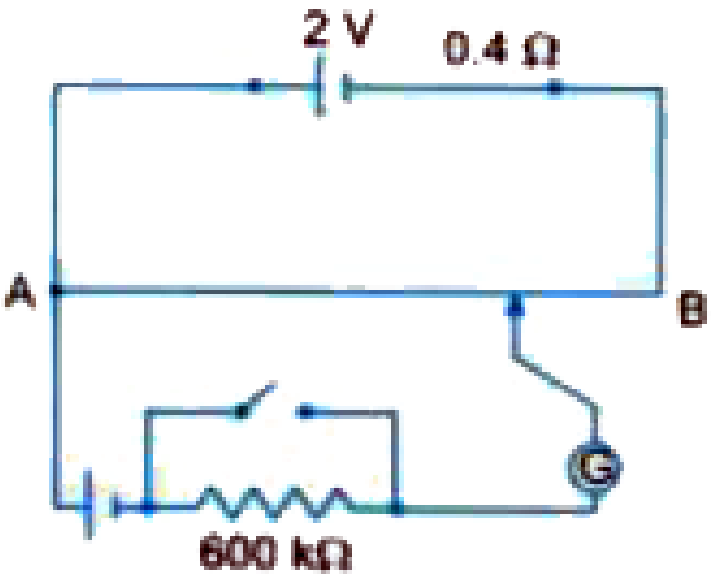


View Text Solution

12. Determine the current drawn from a 12 V supply with internal resistance 0.5Ω by the infinite network shown in Fig. Each resistor has 1Ω resistance.



View Text Solution



13.

Fig. shows a potentiometer with a cell of 2.0 V and internal resistance 0.40 Ω maintaining a potential drop across the resistor wire AB. A standard cell which maintains a constant emf of 1.02 V (for very moderate currents up to a

few mA) gives a balance point at 67.3 cm length of the wire. To ensure very low currents drawn from the standard cell, a very high resistance of 600 kΩ is put in series with it, which is shorted close to the balance point. The standard cell is then replaced by a cell of unknown emf and the balance point found similarly, turns out to be at 82.3 cm length of the wire.

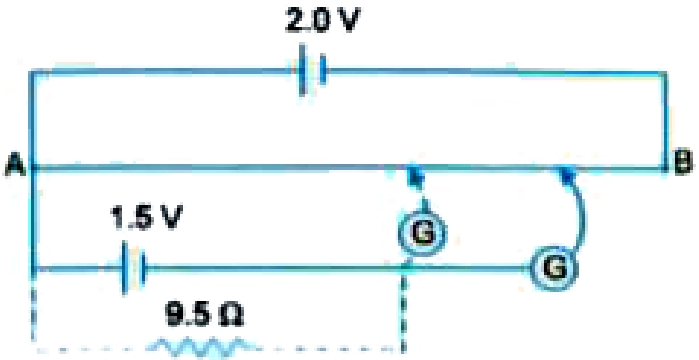
(a) What is the value of ε ? (b) What purpose does the high resistance of 600 kΩ have ? (c) Is the balance point affected by this high resistance ? (d) Would the method work in the

above situation if the driver cell of the potentiometer had an emf of 1.0 V instead of 2.0 V? (e) Would the circuit work well for determining an extremely small emf, say of the order of a few mV (such as the typical emf of a thermo-couple) ? If not, how will you modify the circuit ?

View Text Solution

14. Fig. shows a 2.0 V potentiometer used for the determination of internal resistance of a

1.5 V cell. The balance point of the cell in open circuit is 76.3 cm. When a resistor of 9.5Ω is used in the external circuit of the cell, the balance point shifts to 64.8 cm length of the potentiometer wire. Determine the internal resistance of the cell.



View Text Solution

Case Based Source Based Integrated Questions

1. Answer question on the basis of your understanding of the following paragraph and the related studied concepts :

Bulk matter is made up of many molecules, which are so closely packed that the electrons are no longer attached to individual nuclei. In metallic conductors some of the electrons are practically free to move within the bulk material. Ordinarily, the electrons will be moving due to thermal motion during which

they collide with the fixed ions. An electron colliding with an ion emerges with the same speed as before the collision. However, the direction of its velocity after the collision is completely random and there is no preferential direction for the velocities of the electrons. So number of electrons travelling in any direction will be equal to the number of electrons travelling in the opposite direction and there will be no net flow of electrons and hence no net current.

When an external electric field $\overrightarrow{E}$ is applied across a piece of conductor, electrons will be

accelerated at $\overrightarrow{a} = \frac{e\overrightarrow{E}}{m}$. If $\overrightarrow{a}$ was the velocity of electron after the last collision then velocity $\overrightarrow{v}_t$ after a time t will be $\overrightarrow{v}_t = \overrightarrow{u} + \overrightarrow{a}t$

The average velocity of the electrons at time t is the average of all $\overrightarrow{v}$' s. However, average value of $\overrightarrow{u}$'s is zero. As collisions of the electrons occur at random times, let τ be the average time between successive collision and then the average velocity electrons is expressed as $\overrightarrow{v}_d$ (known as the drift velocity) and is given as:

$$\vec{v}_d = -\frac{e\vec{E}}{m}\tau$$

This drift motion of electrons is responsible for establishment of an electric current in the conductor on applying an external electric field across it. The magnitude of current is given as : $I = nAev_d$, where n= number density of free electrons and A = cross-section area of the conductor. It is to be noted here that drift speed is estimated to be of the order of $10^{-3}ms^{-1}$ for currents in the range of a few amperes.

Define drift velocity. On what factors does it depend ?

View Text Solution

2. Answer question on the basis of your understanding of the following paragraph and the related studied concepts :

Bulk matter is made up of many molecules, which are so closely packed that the electrons are no longer attached to individual nuclei. In metallic conductors some of the electrons are

practically free to move within the bulk material. Ordinarily, the electrons will be moving due to thermal motion during which they collide with the fixed ions. An electron colliding with an ion emerges with the same speed as before the collision. However, the direction of its velocity after the collision is completely random and there is no preferential direction for the velocities of the electrons. So number of electrons travelling in any direction will be equal to the number of electrons travelling in the opposite direction and there will be no net flow of electrons and

hence no net current.

When an external electric field $\overrightarrow{E}$ is applied across a piece of conductor, electrons will be accelerated at $\overrightarrow{a} = \frac{e\overrightarrow{E}}{m}$. If $\overrightarrow{a}$ was the velocity of electron after the last collision then velocity $\overrightarrow{v}_t$ after a time t will be $\overrightarrow{v}_t = \overrightarrow{u} + \overrightarrow{a}t$

The average velocity of the electrons at time t is the average of all $\overrightarrow{v}$ ' s. However, average value of $\overrightarrow{u}$'s is zero. As collisions of the electrons occur at random times, let τ be the average time between successive collision and

then the average velocity electrons is expressed as $\overrightarrow{v}_d$ (known as the drift velocity) and is given as:

$$\overrightarrow{v}_d = -\frac{e\overrightarrow{E}}{m}\tau$$

This drift motion of electrons is responsible for establishment of an electric current in the conductor on applying an external electric field across it. The magnitude of current is given as : $I = nAev_d$, where n= number density of free electrons and A = cross-section area of the conductor. It is to be noted here that drift speed is estimated to be of the

order of $10^{-3} ms^{-1}$ for currents in the range of a few amperes.

If the electron drift speed is so small and the electron charge is small, how can we still obtain large amounts of current even in a thin conducting wire ?

View Text Solution

3. Answer question on the basis of your understanding of the following paragraph and the related studied concepts :

Bulk matter is made up of many molecules, which are so closely packed that the electrons are no longer attached to individual nuclei. In metallic conductors some of the electrons are practically free to move within the bulk material. Ordinarily, the electrons will be moving due to thermal motion during which they collide with the fixed ions. An electron colliding with an ion emerges with the same speed as before the collision. However, the direction of its velocity after the collision is completely random and there is no preferential direction for the velocities of the

electrons. So number of electrons travelling in any direction will be equal to the number of electrons travelling in the opposite direction and there will be no net flow of electrons and hence no net current.

When an external electric field $\overrightarrow{E}$ is applied across a piece of conductor, electrons will be accelerated at $\overrightarrow{a} = \frac{e\overrightarrow{E}}{m}$. If $\overrightarrow{a}$ was the velocity of electron after the last collision then velocity $\overrightarrow{v}_t$ after a time t will be $\overrightarrow{v}_t = \overrightarrow{u} + \overrightarrow{a}t$

The average velocity of the electrons at time t

is the average of all $\vec{v}$ ' s. However, average value of $\vec{u}$'s is zero. As collisions of the electrons occur at random times, let τ be the average time between successive collision and then the average velocity electrons is expressed as $\vec{v}_d$ (known as the drift velocity) and is given as:

$$\vec{v}_d = -\frac{e\vec{E}}{m}\tau$$

This drift motion of electrons is responsible for establishment of an electric current in the conductor on applying an external electric field across it. The magnitude of current is

given as : $I = nAev_d$, where n= number density of free electrons and A = cross-section area of the conductor. It is to be noted here that drift speed is estimated to be of the order of $10^{-3} ms^{-1}$ for currents in the range of a few amperes.

Are the paths of electrons straight lines between successive collisions in the (i) absence of electric field, (ii) presence of electric field ?

View Text Solution

4. Answer question on the basis of your understanding of the following paragraph and the related studied concepts :

Bulk matter is made up of many molecules, which are so closely packed that the electrons are no longer attached to individual nuclei. In metallic conductors some of the electrons are practically free to move within the bulk material. Ordinarily, the electrons will be moving due to thermal motion during which they collide with the fixed ions. An electron colliding with an ion emerges with the same speed as before the collision. However, the

direction of its velocity after the collision is completely random and there is no preferential direction for the velocities of the electrons. So number of electrons travelling in any direction will be equal to the number of electrons travelling in the opposite direction and there will be no net flow of electrons and hence no net current.

When an external electric field $\overrightarrow{E}$ is applied across a piece of conductor, electrons will be accelerated at $\overrightarrow{a} = \frac{e\overrightarrow{E}}{m}$. If $\overrightarrow{a}$ was the velocity of electron after the last collision then

velocity $\vec{v}_t$ after a time t will be

$$\vec{v}_t = \vec{u} + \vec{a}t$$

The average velocity of the electrons at time t is the average of all $\vec{v}$' s. However, average value of $\vec{u}$'s is zero. As collisions of the electrons occur at random times, let τ be the average time between successive collision and then the average velocity electrons is expressed as $\vec{v}_d$ (known as the drift velocity) and is given as:

$$\vec{v}_d = -\frac{e\vec{E}}{m}\tau$$

This drift motion of electrons is responsible

for establishment of an electric current in the conductor on applying an external electric field across it. The magnitude of current is given as : $I = nAev_d$, where n= number density of free electrons and A = cross-section area of the conductor. It is to be noted here that drift speed is estimated to be of the order of $10^{-3} ms^{-1}$ for currents in the range of a few amperes.

Guess the order of magnitude of thermal speed of free electrons in a conductor in the absence of an external electric field.

View Text Solution

5. Answer question on the basis of your understanding of the following paragraph and the related studied concepts :

Bulk matter is made up of many molecules, which are so closely packed that the electrons are no longer attached to individual nuclei. In metallic conductors some of the electrons are practically free to move within the bulk material. Ordinarily, the electrons will be moving due to thermal motion during which they collide with the fixed ions. An electron

colliding with an ion emerges with the same speed as before the collision. However, the direction of its velocity after the collision is completely random and there is no preferential direction for the velocities of the electrons. So number of electrons travelling in any direction will be equal to the number of electrons travelling in the opposite direction and there will be no net flow of electrons and hence no net current.

When an external electric field $\overrightarrow{E}$ is applied across a piece of conductor, electrons will be

accelerated at $\overrightarrow{a} = \frac{e\overrightarrow{E}}{m}$. If $\overrightarrow{a}$ was the velocity of electron after the last collision then velocity $\overrightarrow{v}_t$ after a time t will be $\overrightarrow{v}_t = \overrightarrow{u} + \overrightarrow{a}t$

The average velocity of the electrons at time t is the average of all $\overrightarrow{v}$' s. However, average value of $\overrightarrow{u}$'s is zero. As collisions of the electrons occur at random times, let τ be the average time between successive collision and then the average velocity electrons is expressed as $\overrightarrow{v}_d$ (known as the drift velocity) and is given as:

$$\vec{v}_d = -\frac{e\vec{E}}{m}\tau$$

This drift motion of electrons is responsible for establishment of an electric current in the conductor on applying an external electric field across it. The magnitude of current is given as : $I = nAev_d$, where n= number density of free electrons and A = cross-section area of the conductor. It is to be noted here that drift speed is estimated to be of the order of $10^{-3}ms^{-1}$ for currents in the range of a few amperes.

What is the rate of flow of electric field through the conductor ?

View Text Solution

6. Study the table given below:

Serial No.	1	2	3	4	5	6	7	8	9	10	11	12
Current I (A)	0.2	0.4	0.6	0.8	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
Voltage V (V)	3.9	7.8	11.7	15.7	19.5	39.0	58.5	78.0	97.5	117	136	156

The above table gives I-V relationship for a manganin coil prepared from a wire of cross-section area $1 \times 10^{-7} m^2$ and length 4.1 m.

Now answer the following questions :

(a) Does the maganin coil behave as an ohmic

resistor ?

(b) What is its electrical resistance ?

(c) Determine the resistivity of manganin.

(d) Compare the resistivity of manganin with that of copper.

(e) Why do you consider manganin an ideal choice for preparing standard resistors ?

View Text Solution

7. The following table gives the lengths of four aluminium rods of uniform cross-section their

diameters and potential difference maintained across the opposite ends of the rods. All the four rods are maintained at the same temperature.

Serial no. of rod	Length of the rod	Diameter of the rod	Potential difference
1.	L	3D	V
2.	2L	D	3V
3.	3L	2D	2V
4.	3L	D	V

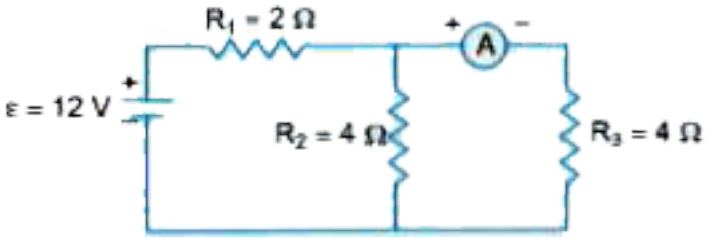
Now answer the following questions :

(a) Which rod has maximum resistance ? (b) Which rod carries the maximum current ? (c) In which rod is the drift speed of electrons maximum ? (d) In which rod does the dissipation of electric energy take place at a

maximum rate ? Give reason for each of your answer.

View Text Solution

8. An ideal battery of emf 12 V is connected across an electric network shown here.



Now answer the following questions:

The equivalent resistance of the network is :

A. 2Ω

B. 4Ω

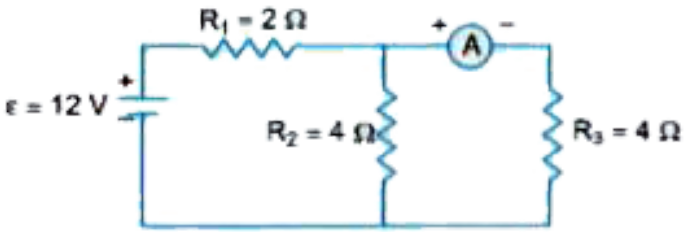
C. 1.6Ω

D. 10Ω

Answer: B

View Text Solution

9. An ideal battery of emf 12 V is connected across an electric network shown here.



Now answer the following questions:

Net current drawn by the circuit from the battery is:

A. 6A

B. 1A

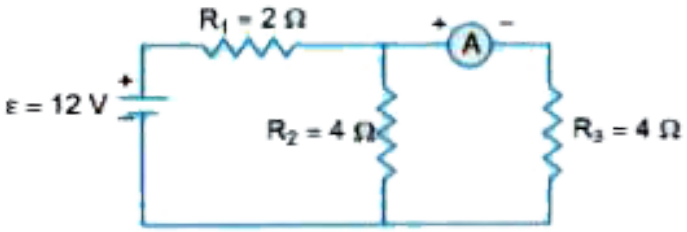
C. 3A

D. 2A

Answer: C

View Text Solution

10. An ideal battery of emf 12 V is connected across an electric network shown here.



Now answer the following questions:

The reading of ammeter A is

A. 3A

B. 1.5A

C. 1A

D. 2A

Answer: B

View Text Solution

Multiple Choice Questions

1. Which of the following characteristics of electrons determines the current in a conductor ?

A. Drift velocity alone.

B. Thermal velocity alone.

C. Both drift velocity and thermal velocity.

D. Neither drift nor thermal velocity.

Answer: A

View Text Solution

2. The potential difference applied to an X-ray tube is 5 kV and the current through it is 3.2

mA. The number of electrons striking the target per second is

A. 5×10^{16}

B. 2×10^{16}

C. 1×10^{17}

D. 4×10^{15}

Answer: B

View Text Solution

3. A metallic wire of resistance 12Ω is bent to form a square. The resistance between two diagonal points would be

A. 12Ω

B. 24Ω

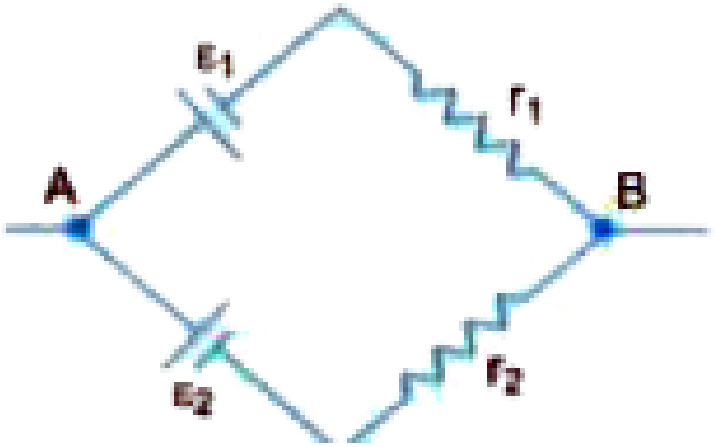
C. 6Ω

D. 3Ω

Answer: D

View Text Solution

4. Two batteries of emf ε_1 and $\varepsilon_2(\varepsilon_2 > \varepsilon_1)$ and internal resistances r_1 and r_2 respectively are connected in parallel as shown in Fig. Then



A. the equivalent emf ε_{eq} of the two cells is betweenε_1 and ε_2 i.e., $\varepsilon_1 < \varepsilon_{eq} < \varepsilon_2$

B. the equivalent emf ε_{eq} is smaller than ε_1

C. the ε_{eq} is given by $\varepsilon_{eq} = \varepsilon_1 + \varepsilon_2$ always .

D. ε_{eq} is independent of internal resistances r_1 and r_2

Answer: A

View Text Solution

5. A steady current flows in a metallic conductor of non-uniform cross-section. The

quantity(s) remaining constant along the length of conductor is/are

A. current, electric field and drift velocity.

B. drift speed only

C. current and drift speed.

D. current only.

Answer: D

View Text Solution

6. Constanton or manganin is widely used in wire wound standard resistors because of their

A. temperature independent resistivity.

B. very weakly temperature dependent resistivity.

C. strong dependence of resistivity on temperature.

D. mechanical strength.

Answer: B

View Text Solution

7. A cell can be balanced against 100 cm and 110 cm of a potentiometer wire respectively with and without being short circuited through a resistance of 10 Ω . Its internal resistance is

A. 0

B. 1.0Ω

C. 0.5Ω

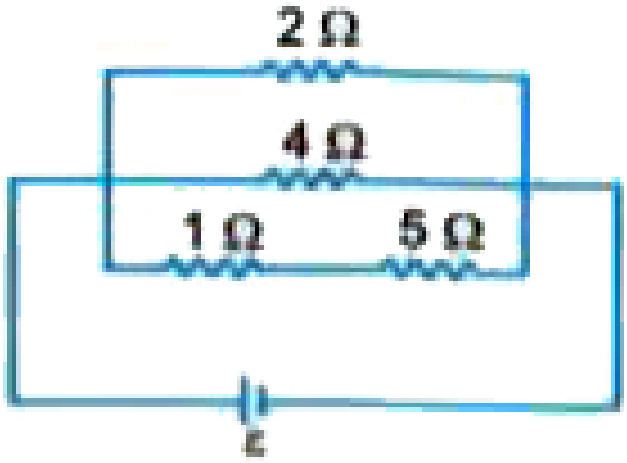
D. 2.0Ω

Answer: B

View Text Solution

8. A current of 3 A flows through the 2Ω resistor shown in the circuit. The power

dissipated in the 5 Ω resistor is



A. 5 watt.

B. 4 watt.

C. 2 watt.

D. 1 watt

Answer: A

View Text Solution

9. The Kirchhoff's first law $\left(\sum i = 0\right)$ and second law $\left(\sum iR = \sum \varepsilon\right)$, where the symbols have their usual meanings, are respectively based on

A. conservation of charge, conservation of momentum.

B. conservation of energy, conservation of charge.

C. conservation of momentum, conservation of charge.

D. conservation of charge, conservation of energy.

Answer: D

View Text Solution

10. If a wire is stretched to make it 0.1% longer, its resistance will

A. decrease by 0.2%

B. decrease by 0.05%

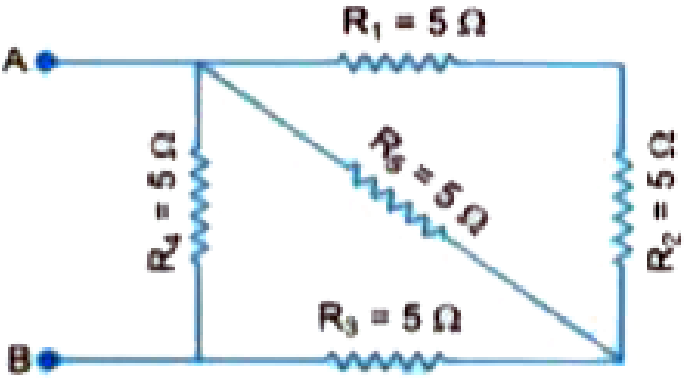
C. increase by 0.05%

D. increase by 0.2%

Answer: D

View Text Solution

11. The equivalent resistance between the points A and B in A the circuit shown in Fig. is



A. 3.12Ω

B. 1.56Ω

C. 6.24Ω

D. 12.48Ω

Answer: A

View Text Solution

12. Three resistances P, Q, R each of 2 12 and an unknown resistance S form the four arms of a Wheatstone bridge circuit. When a resistance of 6Ω is connected in parallel to S, the bridge gets balanced. What is the value of S?

A. 3Ω

B. 6Ω

C. 1Ω

D. 2Ω

Answer: A

View Text Solution

13. The resistance of a wire is 5Ω at 50°C and 6Ω at $100^\circ C$. The resistance of the wire at $0^\circ C$ will be

A. 3Ω

B. 2Ω

C. 1Ω

D. 4Ω

Answer: D

View Text Solution

14. A current of 2 A flows through a 2Ω resistor when connected across a battery. The same battery supplies a current of 0.5 A when connected across a 9 Ω resistor. The internal resistance of the battery is

A. 1Ω

B. 2Ω

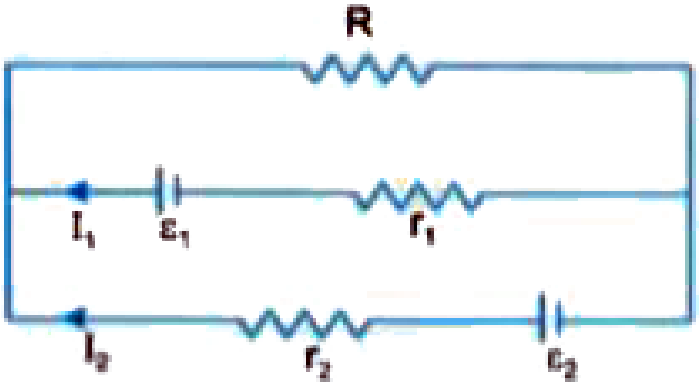
C. $\frac{1}{3}\Omega$

D. $\frac{1}{4}\Omega$

Answer: C

View Text Solution

15. See the electrical circuit shown in Fig. Which of the following equations is a correct equation for it ?



A. $\varepsilon_1 - (i_1 + i_2)R - i_1 r_1 = 0$

B. $\varepsilon_2 - i_2 r_2 - \varepsilon_1 - i_1 r_1 = 0$

C. $-\varepsilon_2 - (i_1 + i_2)R + i_2 r_2 = 0$

D. $\varepsilon_1 - (i_1 + i_2)R + i_1 r_1 = 0$

Answer: A

View Text Solution

16. The colour sequence in a carbon resistor is red, brown, orange and silver. The resistance of the resistor is

A. $21 \times 10^5 \Omega \pm 10\,\%$

B. $23 \times 10^1 \Omega \pm 10\,\%$

C. $21 \times 10^3 \Omega \pm 5\,\%$

D. $12 \times 10^7 \Omega \pm 5\,\%$

Answer: A

View Text Solution

17. If length of a given wire increases by 10% due to stretching, the resistance of the wire increases by

A. 0.21

B. 0.2

C. 0.1

D. 0.05

Answer: A

View Text Solution

18. Drift speed v_d of electrons in a conductor varies with the strength of electric field E as per the relation :

A. $v_d \propto E$

B. $v_d \propto \frac{1}{E}$

C. $v_d \propto E^2$

D. v_d does not depends on E

Answer: A

View Text Solution

19. Electric field E, current density J and conductivity σ of a conductor are correlated as per the relation :

A. $E = \sigma J$

B. $E = \frac{J}{\sigma}$

C. $E = \frac{\sigma}{J}$

D. $J = E^2\sigma$

Answer: B

View Text Solution

20. Which of the following has a negative temperature gradient ?

A. Copper

B. Iron

C. Nickel

D. Carbon

Answer: D

View Text Solution

21. An electron revolves in a circular loop with a frequency of 6×10^{15} cps. The current in the loop is

A. 0.96 mA

B. $0.96\mu A$

C. $28.8mA$

D. $0.96A$

Answer: A

View Text Solution

22. We have two wires A and B of same mass and same material. The diameter of wire A is half of that of B. If the resistance of the wire A

is 24 Ω , then the resistance of the wire B will be

A. 12Ω

B. 3Ω

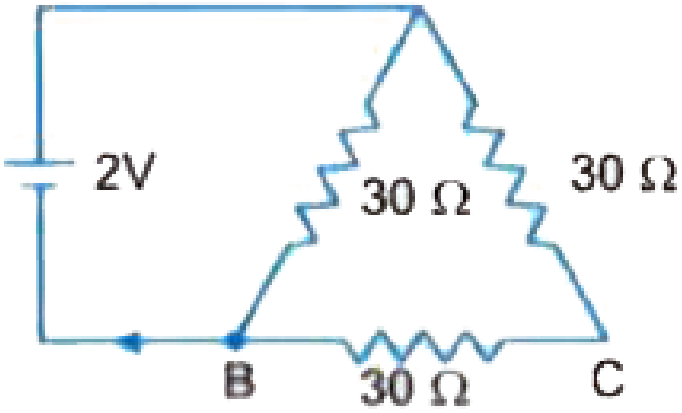
C. 1.5Ω

D. 48Ω

Answer: C

View Text Solution

23. The current I in the adjoining circuit is



A. $\frac{1}{45}A$

B. $\frac{1}{15}A$

C. $\frac{1}{10}A$

D. $\frac{1}{5}A$

Answer: C

View Text Solution

24. Three resistors of resistance $2\Omega, 5\Omega$ and 3Ω respectively are connected in parallel across a battery of 10 volts and negligible resistance. The potential difference across 5 Ω resistor is

A. 5V

B. 2V

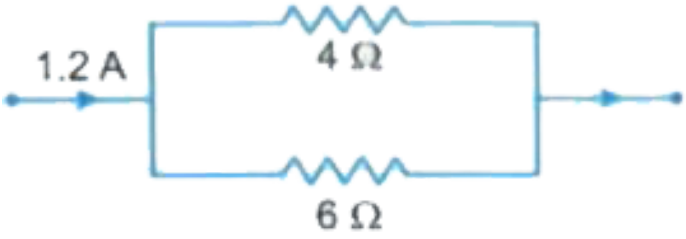
C. 3V

D. 10V

Answer: D

View Text Solution

25. In the adjacent circuit given here, the current passing through 6Ω resistor is



A. 0.4A

B. 0.48A

C. 0.72A

D. 0.8A

Answer: B

View Text Solution

26. A wire of resistance 16 Ω is cut into 4 equal parts. These parts are then connected in parallel. The equivalent resistance of the combination is

A. 16Ω

B. 4Ω

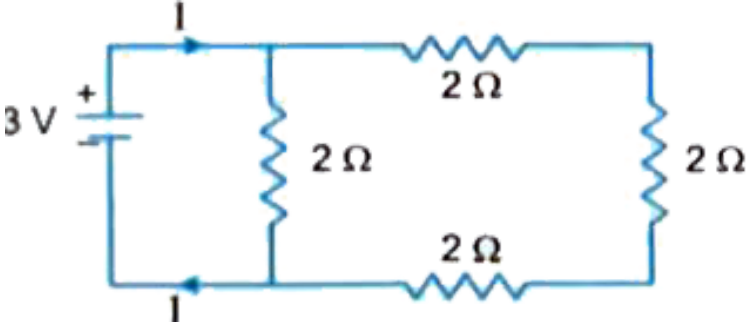
C. 64Ω

D. 1Ω

Answer: D

View Text Solution

27. What is the current I in the circuit shown in adjoining Fig. ?



A. 2A

B. 1.2A

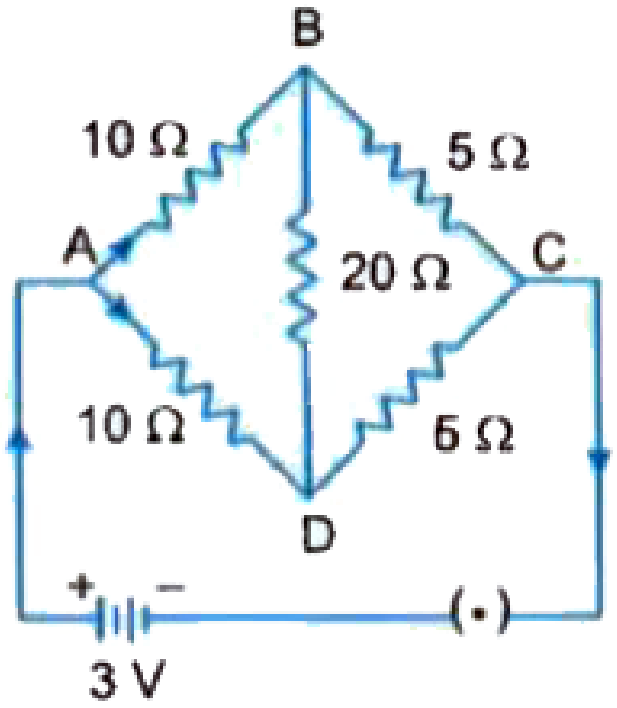
C. 1A

D. 0.5A

Answer: A

View Text Solution

28. The current passing through 20Ω resistance in the circuit arrangement shown here will be



A. 0.1A

B. 0.2A

C. 0.5A

D. 0

Answer: D

View Text Solution

29. The current in a simple series circuit is 5 A. When an additional resistance of 2Ω is inserted, the current drops to 4 A. The original resistance of the circuit was

A. 8Ω

B. 10Ω

C. 1.25Ω

D. 2.5Ω

Answer: A

View Text Solution

30. The terminal potential difference of a cell is greater than its emf when it is

A. being discharged

B. being charged

C. in open circuit

D. short circuited

Answer: B

View Text Solution

31. A cell of emf 2.0 V and internal resistance 0.1 Ω is connected with a resistance of 3.9Ω. The voltage across the cell terminals will be

A. 0.50 V

B. 1.90 V

C. 1.95 V

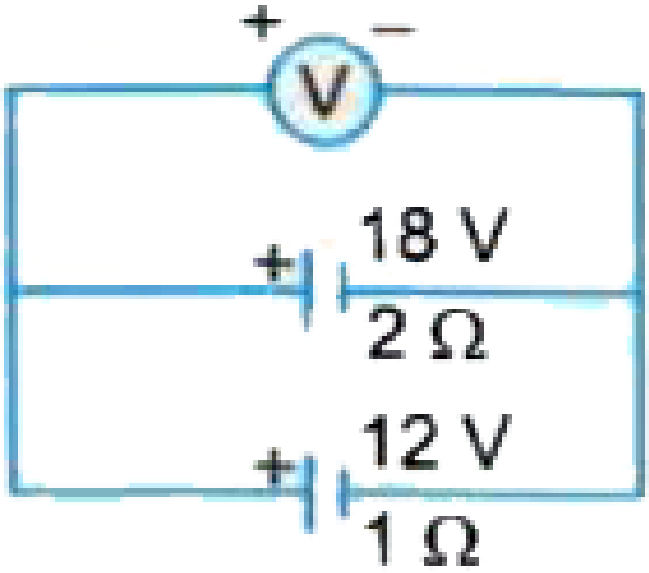
D. 2.0 V

Answer: C

View Text Solution

32. Two batteries, one of emf 18 V and internal resistance 2 Ω and the other of emf 12 V and internal resistance 1Ω , are connected in

parallel as shown in Fig. The voltmeter V will record a reading of



A. 15V

B. 14V

C. 30V

D. 18V

Answer: B

View Text Solution

33. A battery of emf 6 V and negligible internal resistance is connected to the terminals of a potentiometer wire of length 4 m. The wire is of uniform cross-section and its resistance is 100 Ω . The difference of potential between two points separated by 40 cm on the wire will be

A. 0.4 V

B. 0.6 V

C. 1.0 V

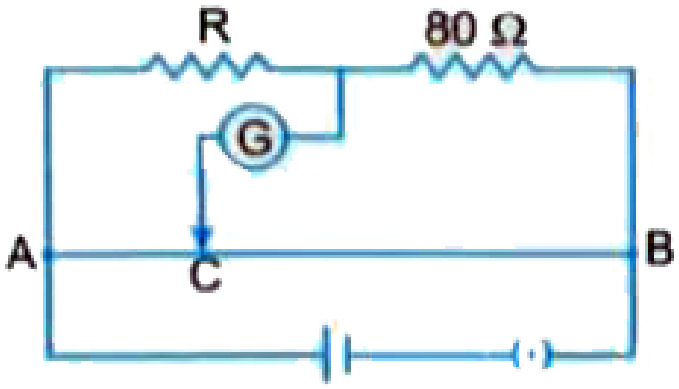
D. 2V

Answer: B

View Text Solution

34. AB is a uniform resistance wire of 1 m length. The galvanometer G shows no deflection when the length AC = 20 cm. The

resistance R is equal to



A. 2Ω

B. 8Ω

C. 20Ω

D. 40Ω

Answer: C

View Text Solution

35. A potentiometer consists of a wire of length 4 m and resistance 20Ω . If it is connected to a cell of emf 20 volt, the potential difference per unit length of the wire will be

A. $0.5Vm^{-1}$

B. $2Vm^{-1}$

C. $5Vm^{-1}$

D. $1.0Vm^{-1}$

Answer: A

View Text Solution

Fill In The Blanks

1. Electric current density is a_____ quantity whereas electric current is a _____ quantity.

View Text Solution

2. The drift velocity of free electrons in metals is of the order of_____.

View Text Solution

3. Temperature coefficient of resistance for_____ Is positive but for ___ and ___ is negative.

View Text Solution

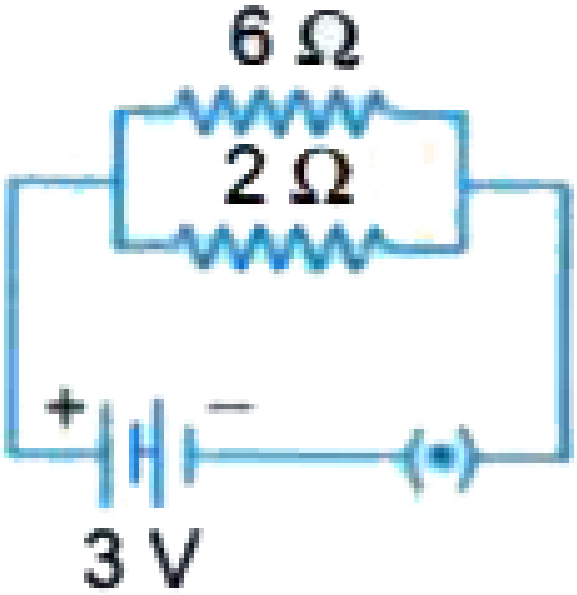
4. The resistivity of a material depends on___and ____

View Text Solution

5. Charge carriers responsible for flow of electricity in gases at low pressure are ___ and ____.

View Text Solution

6.



In the circuit shown here current flowing through 3Ω resistor is _____ .

View Text Solution

7. A resistance R is connected across of a cell of emf ε and internal resistance r and the potential difference between the terminals of cell is found to be V. The internal resistance of the cell is given by the relation r = _____

View Text Solution

8. Conductance is the _____of resistance and its SI units is _____.

View Text Solution

9. The resistance of a carbon resistor having bonds of colours brown, black and brown is___.

View Text Solution

10. Three resistances of 3 Ω each are connected in the form of an equilateral triangle. The effective resistance between any two corners is _____.

View Text Solution

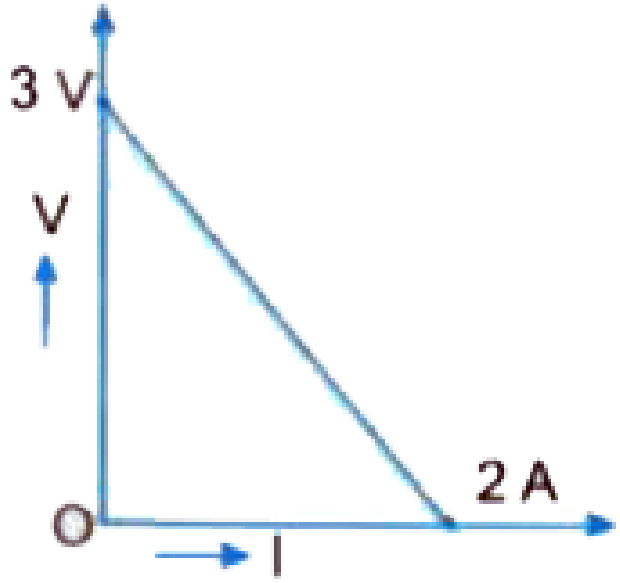
11. Sensitivity of a potentiometer can be increased by _____the length of potentiometer wire.

View Text Solution

12. A cell is balanced on 125 cm length of a potentiometer wire. Now the cell is short circuited by a resistance of 2 Ω and the

balance is obtained at 100 cm. The internal resistance of the cell is ____.

View Text Solution



13.

Refer to V-I graph shown here, the emf of

voltage supply is _____and internal resistance is _____.

View Text Solution

14. A potential difference V is applied across a given copper wire. If its diameter is doubled keeping all other factors constant, the drift velocity of electrons____.

View Text Solution

15. A metre bridge works on the principle of _____.

View Text Solution

16. A car battery of emf 12 V and internal resistance 0.1 Ω is being charged at a constant current of 5 A. The potential difference between the two terminals of the battery is _____.

View Text Solution

17. Alloys used to make standard resistors have a low value of____ but a high value of ____.

View Text Solution

18. Potential difference between the terminals of a cell/battery is equal to its emf when the cell/battery is___.

View Text Solution

True Or False

1. If the temperature of a metallic conductor is increased, the drift velocity of electrons in the conductor decreases.

View Text Solution

2. Temperature coefficient of resistivity of manganin is very high and due to this reason manganin is used as a resistance wire.

View Text Solution

3. Resistivity of alloys is, in general, less than that of pure metals.

View Text Solution

4. If both the length and radius of a metallic wire are doubled then its resistance remains unchanged.

View Text Solution

5. The colour sequence in a carbon resistor is yellow, blue and green. Its resistance is $46 \times 10^5 \Omega$

View Text Solution

6. Potential difference across the terminals of a cell becomes zero when the terminals are connected by a metallic wire.

View Text Solution

7. In a wheatstone's bridge arrangement we can interchange the cell and galvanometer without affecting the balance condition of the bridge.

View Text Solution

8. Kirchhoff's junction rule is based on the law of conservation of electrical energy.

View Text Solution

9. SI unit of electromotive force of a cell is NC^{-1}

View Text Solution

10. Potential difference across the terminals of a cell is always less than its emf.

View Text Solution

Assertion Reason Type Questions

1. Assertion (A): There is no current in the metals in the absence of an electric field.

Reason (R) : Motion of free electrons are randomly directed in the absence of an electric field.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both assertion and reason are true but reason is not the correct explanation of

the assertion.

C. If assertion is true but reason is false.

D. If the assertion is false but reason is true.

Answer: A

View Text Solution

2. Assertion (A): In our domestic electric circuit an electric bulb glows immediately when the switch is put in ON mode.

Reason (R) : The drift velocity of electrons in metal wires is very high.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both assertion and reason are true but reason is not the correct explanation of the assertion.

C. If assertion is true but reason is false.

D. If the assertion is false but reason is true.

Answer: C

View Text Solution

3. Assertion (A): A potentiometer of longer length is preferred for precise measurement.

Reason (R) : The potential gradient for a potentiometer of longer length with a given source of emf becomes small.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both assertion and reason are true but reason is not the correct explanation of the assertion.

C. If assertion is true but reason is false.

D. If the assertion is false but reason is true.

Answer: A

View Text Solution

4. Assertion (A): The alloys manganin and constant on are used to make standard resistors.

Reason (R) : Resistivity of nichrome is maximum amongst all alloys.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both assertion and reason are true but reason is not the correct explanation of the assertion.

C. If assertion is true but reason is false.

D. If the assertion is false but reason is true.

Answer: B

View Text Solution

5. Assertion (A): The conventional direction of current is taken to be the direction of flow of positive charge.

Reason (R) : Direction of current flow is opposite to the direction of flow of electrons in a conductor.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both assertion and reason are true but reason is not the correct explanation of the assertion.

C. If assertion is true but reason is false.

D. If the assertion is false but reason is true.

Answer: A

View Text Solution

Very Short Answer Questions

1. Is electric current a scalar or a vector ? Why?

View Text Solution

2. Why is the terminal voltage of a cell less than its emf?

View Text Solution

3. What is the difference between terminal voltage and emf of a cell ?

View Text Solution

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

View Text Solution

5. electrical conductivity, has the SI unit "ohm-metre". Identify the physical quantity.

View Text Solution

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

View Text Solution

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

View Text Solution

8. Show on a graph the variation of resistivity with temperature for a typical semiconductor

View Text Solution

9. A wire of resistance 8R is bent in the form of a circle. What is the effective resistance between the ends of a diameter AB ?

View Text Solution

10. Define the term 'drift velocity' of charge carriers in a conductor and write its relationship with the current flowing through it.

View Text Solution

11. Write the expression for the drift velocity of charge carriers in a conductor of length 'l' across which a potential difference 'V' is applied.

View Text Solution

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

View Text Solution

13. A conductor of length L is connected across d.c. source of emf ε . If the conductor is replaced by another of the same material and area of cross-section but of length = 5 L, by what factor will the drift velocity change ?

View Text Solution

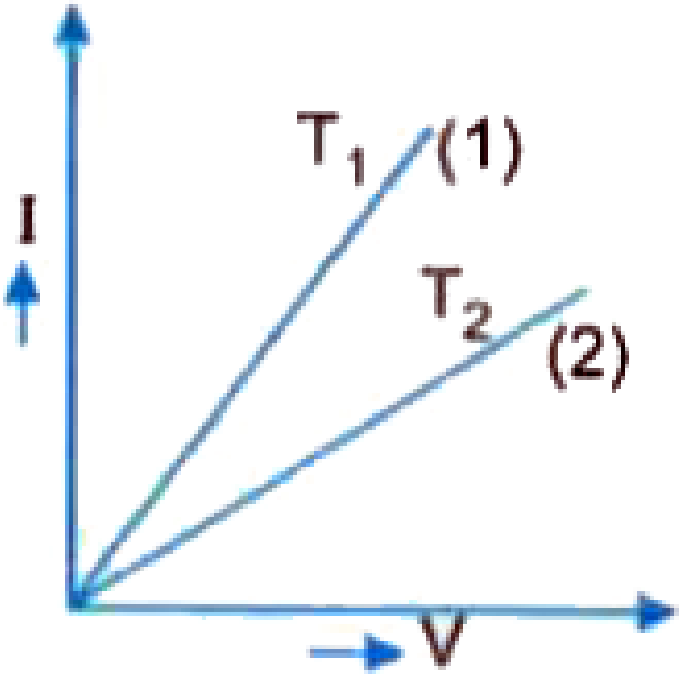
14. Two conducting wires X and Y of same diameter but different materials are joined in

series across a battery. If the number density of electrons in X is twice that in Y, find the ratio of drift velocity of electrons in the two wires.

View Text Solution

15. I-V graph for a given metallic wire at two temperatures T_1 and T_2 is as shown in Fig. Which of the two temperatures is lower and

why?



View Text Solution

16. Two wires of equal length, one of copper and the other of manganin have the same

resistance. Which wire is thicker ?

View Text Solution

17. Nichrome and copper wires of same length and same radius are connected in series. Current I is passed through them. Which wire gets heated up more ? Justify your answer.

View Text Solution

18. Write an expression for the resistivity of a metallic conductor showing its variation over a limited range of temperatures.

View Text Solution

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

View Text Solution

20. 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 ?

View Text Solution

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

View Text Solution

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

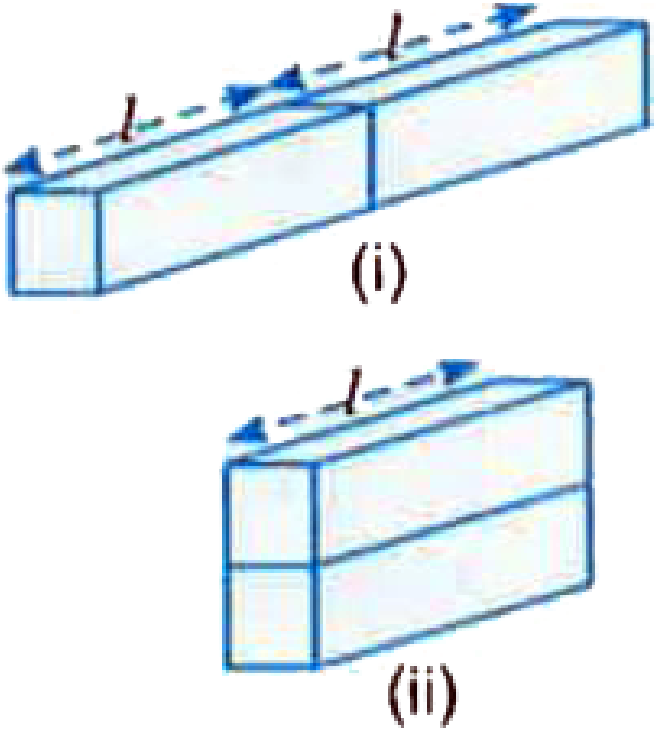
View Text Solution

23. How does the mobility of electrons in a conductor change, if the potential difference applied across the conductor is doubled, keeping the length and temperature of the conductor constant ?

View Text Solution

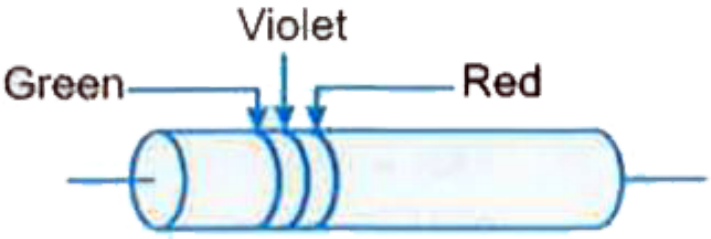
24. Two identical slabs, of a given metal, are joined together, in two different ways, as shown in Fig.(i) and (ii). What is the ratio of

the resistances of these two combinations ?



View Text Solution

25. A carbon resistor is shown in the Fig. Using colour code, write the value of the resistance.



View Text Solution

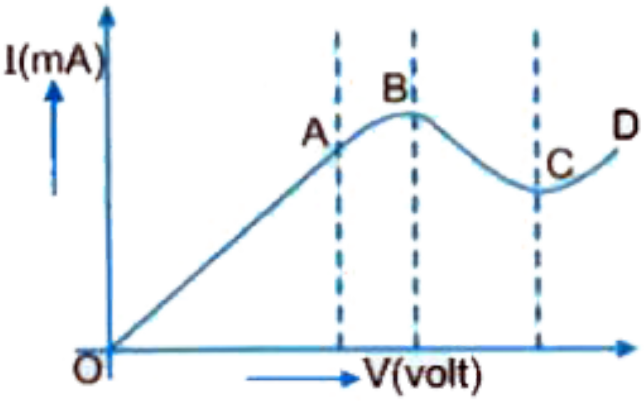
26. The three coloured bands on a carbon resistor are red, green and yellow respectively. Write the value of its resistance.

View Text Solution

27. Two students A and B were asked to pick a resistor of 15 kW from a collection of carbon resistors. A picked a resistor with bands of colours : brown, green, orange but B chose a resistor with bands of black, green, red. Who picked the correct resistor ?

View Text Solution

28. Graph showing the variation of current versus voltage for a material Ga As (a semiconductor) is shown in the Fig. Identify the region of (i) negative resistance, (ii) where Ohm's law is obeyed.



View Text Solution

29. Two identical cells, each of emf ε , having negligible internal resistance, are connected in parallel with each other across an external resistance R. What is the current through this resistance ?

View Text Solution

30. In a metre bridge, two unknown resistances R and S, when connected in the

two gaps, give a null point at 40 cm from one end. What is the ratio of Rand S?

View Text Solution

31. In an experiment on metre bridge the balancing length on wire is 'l'. What would be its value, if the radius of the metre bridge wire is doubled ? Justify your answer.

View Text Solution

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

View Text Solution

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

View Text Solution

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

View Text Solution

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

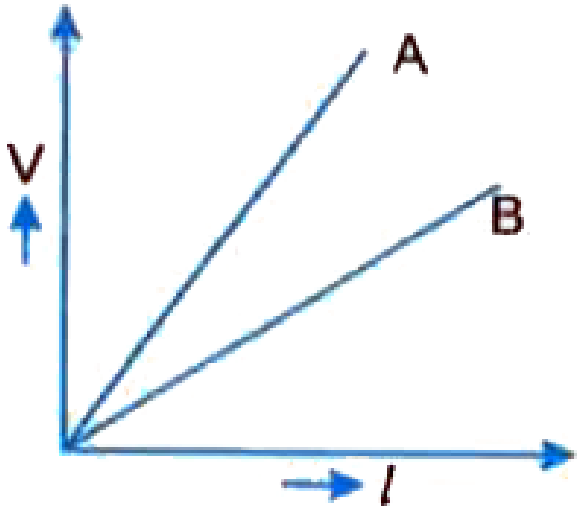
View Text Solution

36. A resistance R is connected across a cell of emf e 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.

View Text Solution

37. The variation of potential difference V with length l in case of two potentiometers A and B

is as shown in Fig. Which one of these two will you prefer for comparing emfs of two primary cells ?



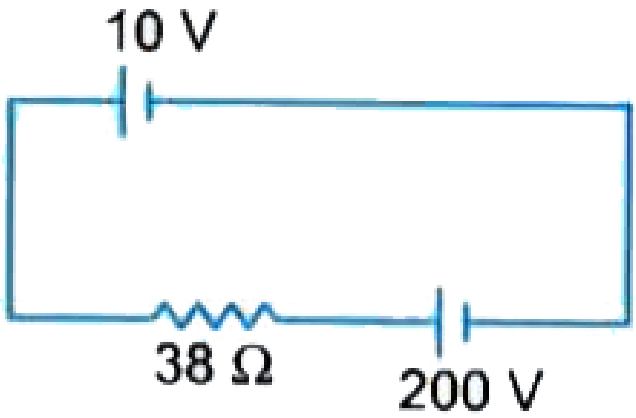
View Text Solution

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

View Text Solution

39. A 10 V battery of negligible internal resistance is connected across a 200 V battery and a resistance of 38 Ω as shown in the Fig.

Find the value of the current in circuit.



View Text Solution

Short Answer Questions

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

View Text Solution

2. Draw a graph showing variation of resistivity with temperature for nichrome. Which property of nichrome is used to make standard resistance coils ?

View Text Solution

3. Explain the term 'drift velocity' of electrons in a conductor. Hence obtain the expression

for the current through a conductor in terms of drift - Temperature T velocity.

View Text Solution

4. Prove that the current density of a metallic conductor is directly proportional to the drift speed of electrons.

View Text Solution

5. Write a relation between current and drift velocity of electrons in a conductor. Use this relation to explain how the resistance of a conductor changes with the rise in temperature.

View Text Solution

6. Using the concept of drift velocity of charge carriers in a conductor, deduce the

relationship between current density and resistivity of the conductor.

View Text Solution

7. How does the resistivity of : (i) a conductor and (ii) a semiconductor vary with temperature ? Give reason for each case.

View Text Solution

8. Using the mathematical expression for the conductivity of a material, explain how it varies with temperature for (i) semiconductors, (ii) good conductors.

View Text Solution

9. Define mobility of a charge carrier. Write the relation expressing mobility in terms of relaxation time. Give its SI unit.

View Text Solution

10. Derive an expression for drift velocity of free electrons in a conductor in terms of relaxation time.

View Text Solution

11. Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area $1.0 \times 10^{-7} m^2$ carrying a current of 1.5 A. Assume the density of conduction electrons to be$9 \times 10^{28} m^{-3}$.

View Text Solution

12. A voltage of 30 V is applied across a carbon resistor with first, second and third rings of blue, black and yellow colours respectively. Calculate the value of current in milliampere through the resistor.

View Text Solution

13. The sequence of coloured bands in two carbon resistors R_1 and R_2 is (i) brown, green, blue and (ii) orange, black, green. Find the ratio of their resistances.

View Text Solution

14. The number density of free electrons in a copper conductor is $8.5 \times 10^{28} m^{-3}$. How long does an electron take to drift from one end of a wire 3.0 m long to its other end ? The

area of cross section of the wire is $2.0 \times 10^{-6} m^2$ and is carrying a current of 3.0 A.

View Text Solution

15. A cylindrical metallic wire is stretched to increase its length by 5%. Calculate the percentage change in its resistance.

View Text Solution

16. Two wires X, Y have the same resistivity, but their cross-sectional areas are in the ratio 2:3 and lengths in the ratio 1:2. They are first connected in series and then in parallel to a d.c. source. Find out the ratio of the drift speeds of the electrons in the two wires for the two cases.

View Text Solution

17. A cell of emf ' ε ' and internal resistance 'r' is connected across a variable resistor 'R'. Plot a graph showing the variation of terminal potential 'V' with resistance R. Predict from the graph the condition under which 'V' becomes equal to $'\varepsilon'$

View Text Solution

18. A cell of emf $'\varepsilon'$ and internal resistance 'r' is connected across a variable resistor 'R'. Plot

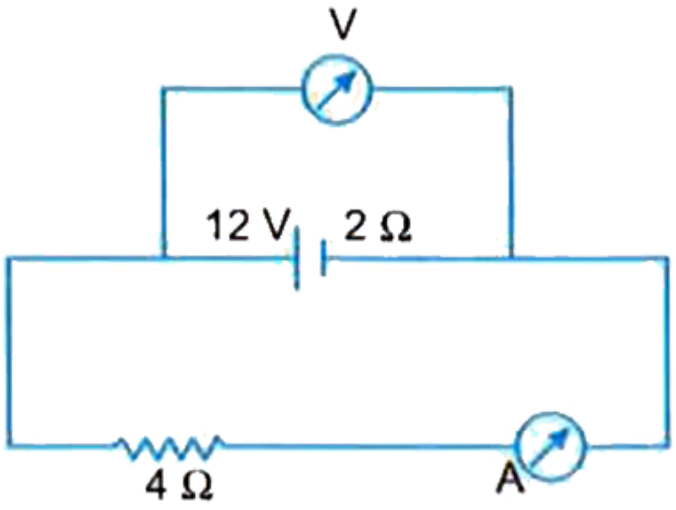
a graph showing variation of terminal voltage 'V' of the cell versus the current 'I'. Using the plot, show how the emf of the cell and its internal resistance can be determined.

View Text Solution

19. Two cells of emfs 1.5 V and 2.0 V having internal resistances 0.2Ω and 0.3Ω respectively are connected in parallel. Calculate the emf and internal resistance of the equivalent cell.

View Text Solution

20. A battery of emf 12 V and internal resistance 2 Ω is connected to a 4 Ω resistor as shown in the Fig. Show that a voltmeter when placed across the cell and across the resistor, in turn, gives the same reading.



View Text Solution

21. A battery of emf 10 V and internal resistance 3Ω is connected to a resistor. If the current in the circuit is 0.5 A, find (i) the resistance of the resistor, (ii) the terminal voltage of the battery.

View Text Solution

22. A battery of emf ε and internal resistance r, when connected across an external resistance of 12 Ω , produces a current of 0.5 A. When

connected across a resistance of 25Ω, it produces a current of 0.25 A. Determine the emf and internal resistance of the cell.

View Text Solution

23. The reading on a high resistance voltmeter, when a cell is connected across it, is 2.2 V. When a 5 Ω resistance is connected across the terminals of the cell in parallel with the voltmeter, the reading is 1.8 V. Determine the internal resistance of the cell.

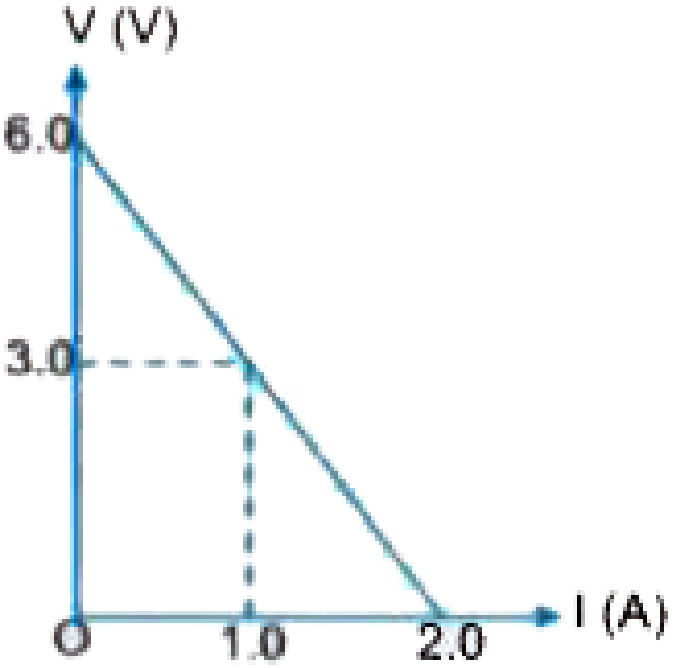
View Text Solution

24. Obtain the formula for the 'power loss' (i.e., power dissipated) in a conductor of resistance R, carrying a current I.

View Text Solution

25. The adjoining graph shows the variation of terminal potential difference V, across a combination of three cells in series to a resistor, versus the current, I:

(i) Calculate the emf of each cell. (ii) For what current I, will the power dissipation of the circuit be maximum ?



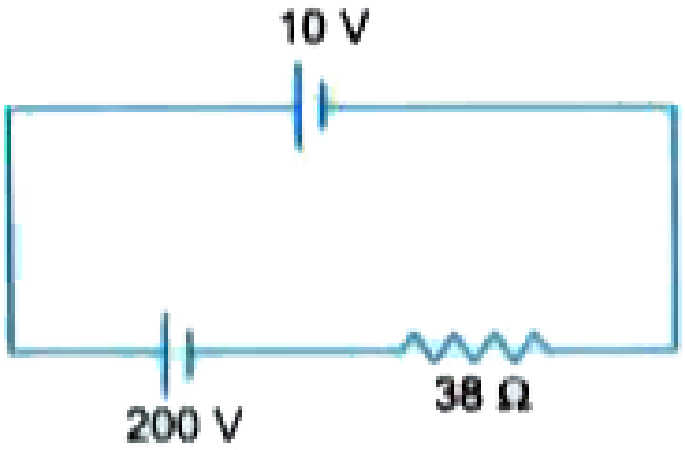
View Text Solution

26. Two cells of emf 2ε and ε and internal resistance 2r and r respectively, are connected in parallel. Obtain the expressions for the equivalent emf and the internal resistance of the combination.

View Text Solution

27. A 10 V cell of negligible internal resistance is connected in parallel across a battery of emf 200 V and internal resistance 38 Ω as shown in

the Fig. Find the value of current in the circuit.



View Text Solution

28. Two bulbs are rated (P_1, V) and (P_2, V). If they are connected (i) in series and (ii) in parallel across a supply

V, find the power dissipated in the two combinations in terms of P_1 and P_2.

View Text Solution

29. A cell of emf ε and internal resistance r is connected to two external resistances, R_1 and R_2 and a perfect ammeter. The current in the circuit is measured in four different situations: (i) Without any external resistance in the circuit, (ii) with resistance R_1 only (iii) with R_1 and R_2 in series combination, (iv) with R_1 and

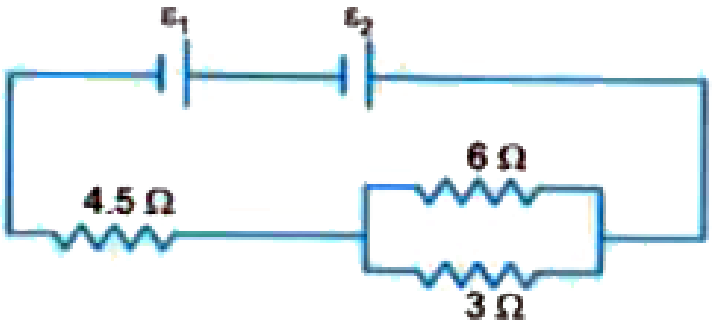
R_2 in parallel combination.

The currents measured in the four cases are 0.42 A, 1.05 A, 1.4 A and 4.2 A, but not necessarily in that order. Identify the currents corresponding to the four cases mentioned above

View Text Solution

30. Two cells ε_1 and ε_2 in the given circuit diagram have an emf of 5 V and 9 V and internal resistance of 0.3 Ω and 1.2Ω

respectively. Calculate the value of current flowing through the resistance of 3 Ω .



View Text Solution

31. Draw the diagram of Wheatstone bridge. Why does no current flow through the galvanometer when the bridge is balanced ?

View Text Solution

32. Explain the principle on which the working of a potentiometer is based. Why is the use of a potentiometer preferred over that of a voltmeter for measurement of emf of a cell ?

View Text Solution

33. Two students X and Y perform an experiment on potentiometer separately using the circuit diagram shown here. Keeping other things unchanged

(i) X increases the value of resistance R (ii) Y decreases the value of resistance S in the set up. How would these changes affect the position of the null point in each case and why ?

View Text Solution

34. In a potentiometer arrangement for determining the emf of a cell, the balance point of the cell in open circuit is 350 cm. When a resistance of 9Ω is used in the

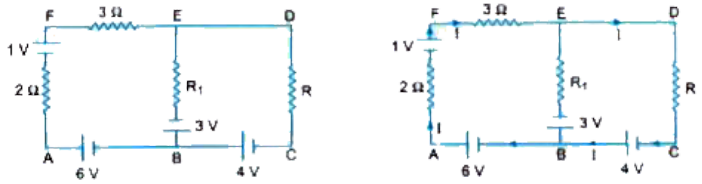
external circuit of the cell, the balance point shifts to 300 cm. Determine the internal resistance of the cell.

View Text Solution

35. In the given circuit, assuming point A to be at zero potential, use Kirchhoff's rules to determine the potential at point B.

View Text Solution

36. Use Kirchhoff's rules to determine the potential difference between the points A and D when no current flows in the arm BE of the electric network shown in the Fig.



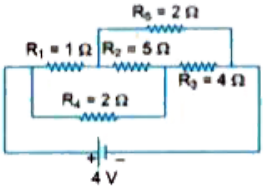
View Text Solution

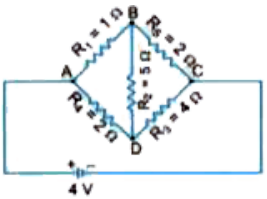
37. A wire of 15 Ω resistance is gradually stretched to double its original length. It is

then cut into two equal parts. These parts are then connected in parallel across a 3.0 volt battery. Find the current drawn from the battery.

View Text Solution

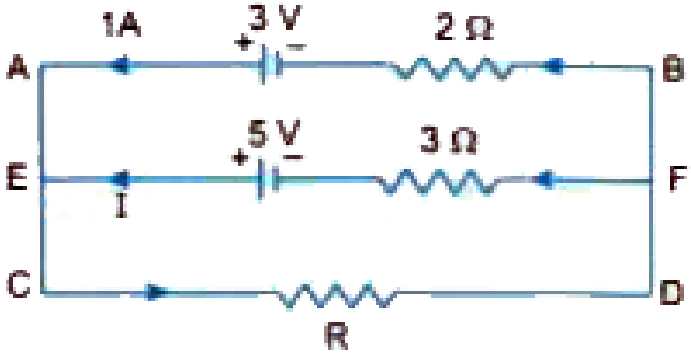
38. Calculate the current drawn from the battery in the given network .





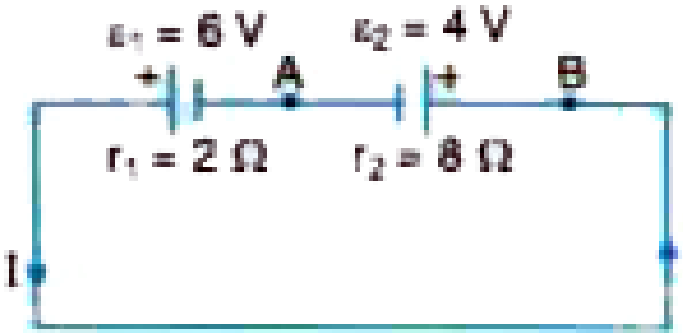
View Text Solution

39. Using Kirchhoff's rules in the circuit shown determine (a) the voltage drop across the unknown resistor R, and (b) the current I in the arm EF.



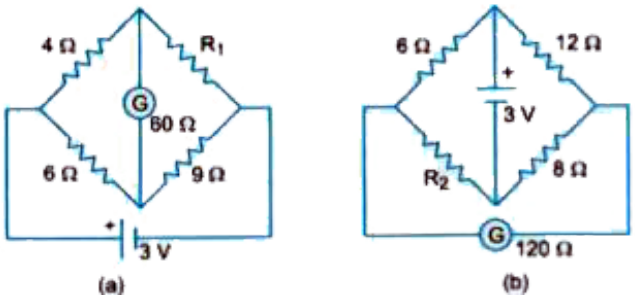
View Text Solution

40. The circuit in Fig. shows two cells connected in opposition to each other. Cell ε_1, is of emf 6 V and internal resistance 2Ω and the cell ε_2 is of emf 4 V and internal resistance 8 Ω. Find the potential difference between the points A and B.



View Text Solution

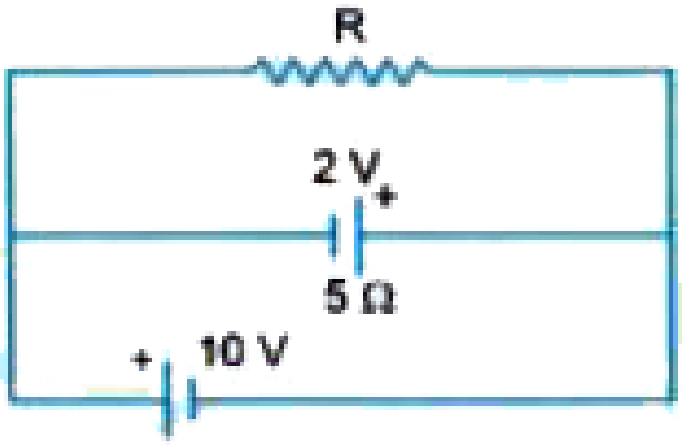
41. Figure shows two circuits each having a galvanometer and a battery of 3 V. When the galvanometer in each arrangement do not show any deflection, find the ratio of $\frac{R_1}{R_2}$



View Text Solution

42. Two cells, of voltage 10 V and 2 V and internal resistances 10Ω and 5Ω respectively,

are connected in parallel as shown in Fig. Find the effective voltage and effective resistance of the combination.



View Text Solution

Long Answer Questions I

1. The electron drift speed is estimated to be only a few mm s^{-1} for currents in the range of a few amperes. How then is current established almost the instant a circuit is closed ?

View Text Solution

2. The electron drift arises due to the force experienced by electrons in the electric field inside the conductor. But force should cause

acceleration. Why then do the electrons acquire a steady average drift speed ?

View Text Solution

3. If the electron drift speed is so small and the electron's charge is small, how can we still obtain large amounts of current in a conductor ?

View Text Solution

4. 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 ?

View Text Solution

5. Are the paths of electrons straight lines between successive collisions (with the positive ions of the metal) in the (i) absence of electric field, (ii) presence of electric field ?

View Text Solution

6. Define the terms (i) drift velocity, (ii) relaxation time. A conductor of length L is connected to a d.c. source of emf ε . If this conductor is replaced by another conductor of same material and same area of cross-section but of length 3L, how will the drift velocity change ?

View Text Solution

7. Derive an expression for the resistivity of a good conductor in terms of the relaxation time of electrons.

View Text Solution

8. Define relaxation time of the free electrons drifting in a conductor. How is it related to the drift velocity of free electrons ? Use this relation to deduce the expression for the electrical resistivity of the material.

View Text Solution

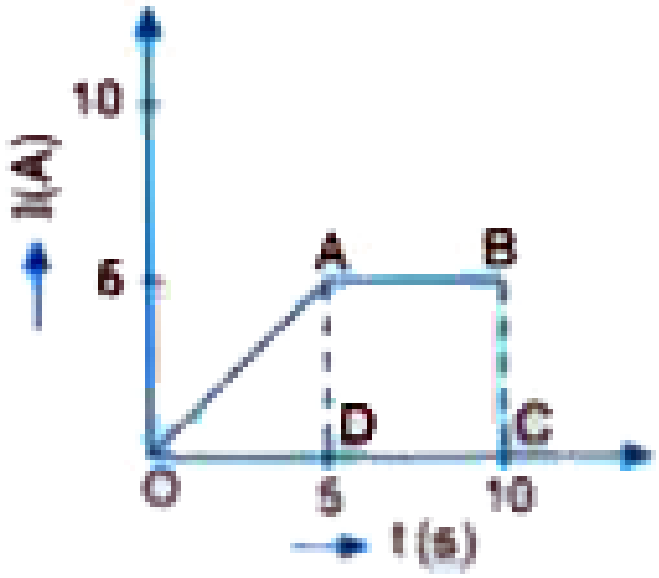
9. Define the term current density of a metallic conductor. Deduce the relation connecting current density (J) and the conductivity (σ) of the conductor when an electric field E is applied to it.

View Text Solution

10. (a) Deduce the relation between current I flowing through a conductor and drift velocity

$\overrightarrow{v}_d$ of the electrons.

(b) Figure shows a plot of current I flowing through the cross section of a wire versus the time t. Use the plot to find the charge flowing in 10 s through the wire.



View Text Solution

11. (a) Define the term conductivity of a metallic wire. Write its SI unit.

(b) Using the concept of free electrons in a conductor, derive the expression for the conductivity of a wire in terms of number density and relaxation time. Hence obtain the relation between current density and the applied electric field E.

View Text Solution

12. A cell of emf ε and internal resistance 'r' is connected across a variable load resistor 'R'. Draw the plots of the terminal voltage 'V' versus (i) R and (ii) the current I.

It is found that when R = 4 Ω , the current is 1 A and when R is increased to 9 Ω , the current reduces to 0.5 A. Find the values of the emf ε and internal resistance r.

View Text Solution

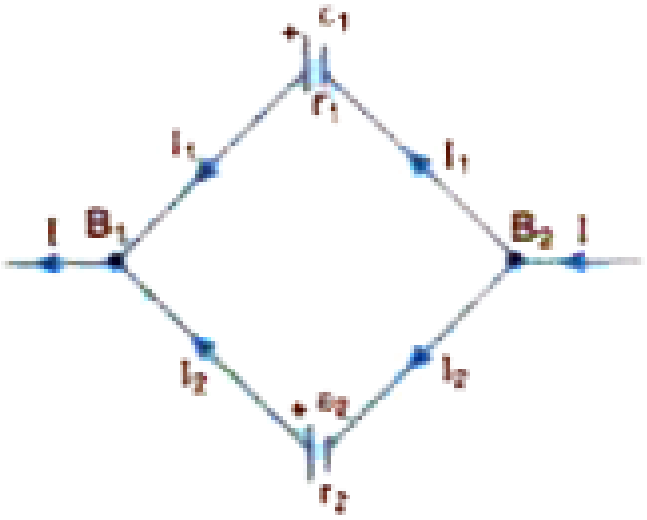
13. A number of identical cells, n, each of emf ε , internal resistance r connected in series are charged by a d.c. source of emf ε , using a resistor R.

(i) Draw the circuit arrangement.

(ii) Deduce the expressions for (a) the charging current and (b) the potential difference across the combination of the cells.

View Text Solution

14. Two cells of emf ε_1 and ε_2 having internal resistances r_1 and r_2 respectively are connected in parallel as shown in Fig. Deduce the expressions for the equivalent emf and equivalent internal resistance of a cell which can replace the combination between the points B_1 and B_2 .

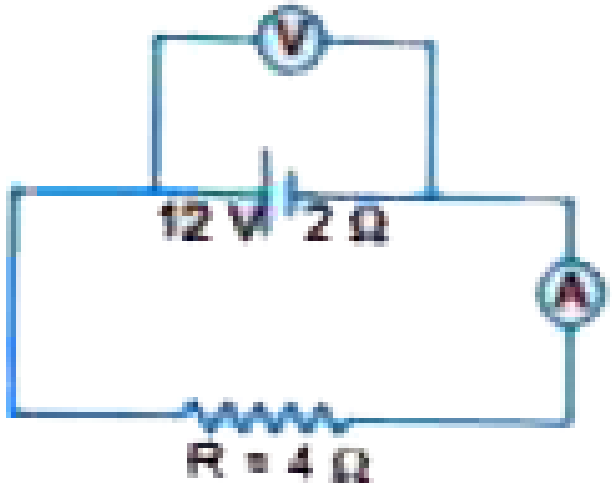


View Text Solution

15. (a) The potential difference applied across a given resistor is altered so that the heat produced per second increases by a factor us 9. By what factor docs the applied potential difference change?

(b) In the figure shown, an ammeter A and a resistor of 4Ω are connected to the terminals of the source. The emf of the source is 12 V having an internal resistance of 2Ω . Calculate

the voltmeter and ammeter readings.



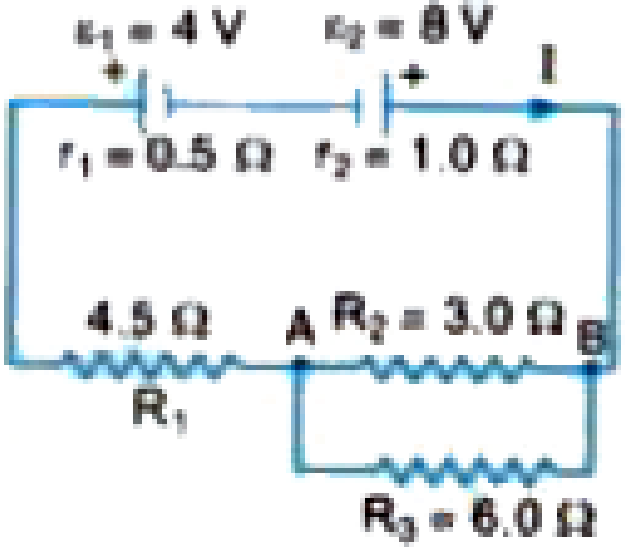
View Text Solution

16. The temperature coefficient of resistivity for two materials A and B are $0.0031/^{\circ}C$, and $0.0068/^{\circ}C$ respectively. Two resistors R_1 and R_2, made from material A and B respectively,

have resistances of 200 Ω and 100 Ω at $0^{\circ} C$. Show the colour code of a carbon resistor that would have a resistance equal to the series combination of R_1 and R_2 at a temperature of $100^{\circ} C$ (Neglect the ring corresponding to the tolerance of the carbon resistor).

View Text Solution

17. In the circuit shown , find the current through resistors.



View Text Solution

18. Use Kirchhoff's rules to obtain the balance condition in a Wheatstone bridge.

View Text Solution

19. With the help of a circuit diagram, explain the working principle of metre bridge. How is it used to determine the unknown resistance of a given wire ? Write the necessary precautions to minimise error in the result.

View Text Solution

20. State the working principle of a potentiometer. With the help of the circuit diagram explain how a potentiometer is used to compare the emfs of two primary cells.

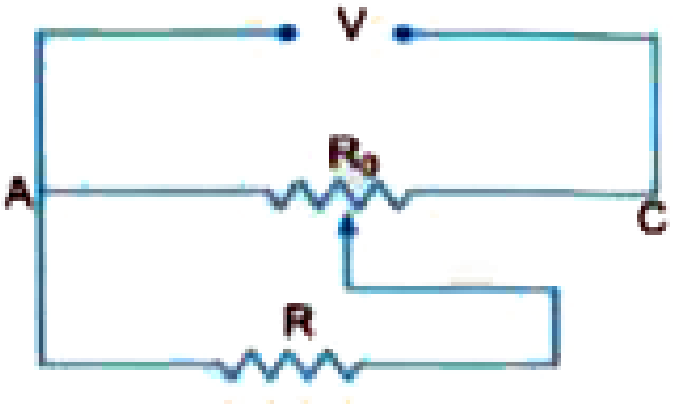
Obtain the required expression used for comparing the emfs.

View Text Solution

21. Write the principle of working of a potentiometer. Describe briefly, with the help of a circuit diagram, how a potentiometer is used to determine the internal resistance of a cell.

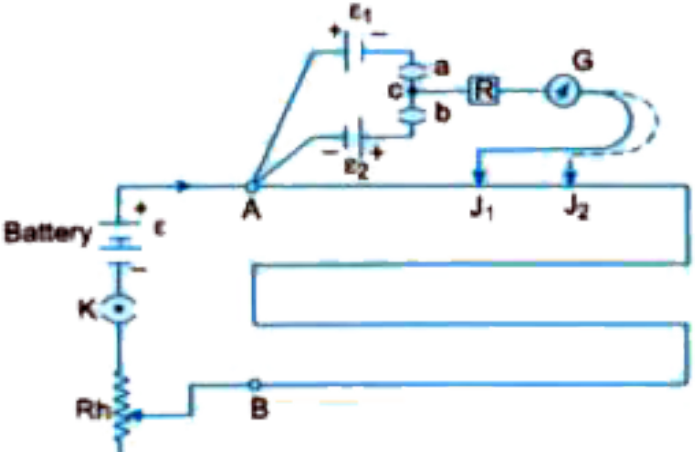
View Text Solution

22. A resistance of RΩ draws current from a potentiometer as shown in Fig. The potentiometer has a total resistance $R_0\Omega$. A voltage Vis supplied to the potentiometer. Derive an expression for the voltage across R when the sliding contact is in the middle of the potentiometer.



View Text Solution

23. A student uses the circuit diagram of a potentiometer as shown in Fig.



(a) For a steady current I passing through the potentiometer wire, he gets a null point for the cell $\varepsilon_1$and not for ε_2 . Give reason for this observation and suggest how this difficulty can be resolved.

(b) What is the function of resistance R used in the circuit? How will the change in its value affect the null point ?

(c) How can the sensitivity of the potentiometer be increased?

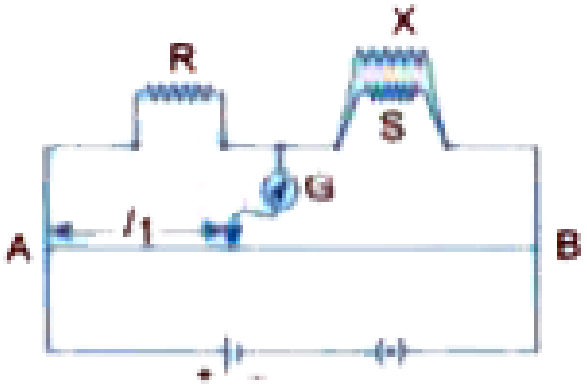
View Text Solution

24. (i) State the principle of working of a metre bridge.

(ii) In a metre bridge balance point is found at a distance l_1 with resistances R and S as

shown in the figure.

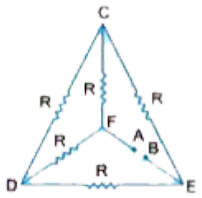
When an unknown resistance X is connected in parallel with the resistance S, the balance point shifts to a distance l. Find the expression for X in terms of l_1, l_2 and S.

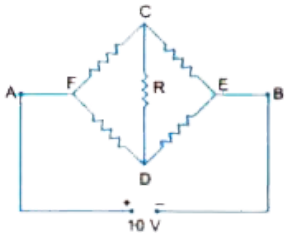


View Text Solution

25. (i) Calculate the equivalent resistance of the given electrical network between points A and B.

(ii) Also calculate the current through CD and ACB, if a 10 V d.c. source is connected between A and B and the value of R is assumed as 2Ω.

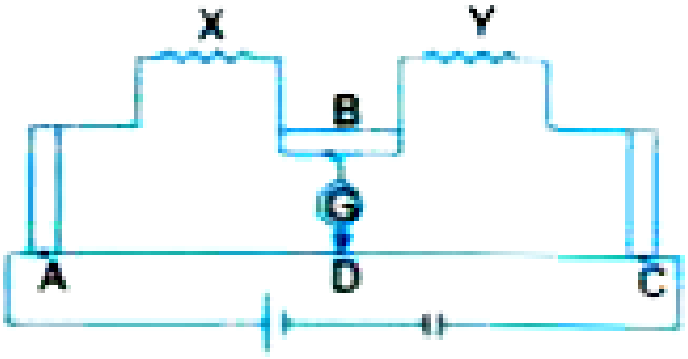




View Text Solution

26. The Fig. shows experimental set up of a metre bridge. When the two unknown resistances X and Yare inserted, the null point Dis obtained 40 cm from the end A. When a resistance of 10Ω is connected in series with X, the null point shifts by 10 cm. Find the position of the null point when the 10Ω resistance is instead | A connected in series with resistance 'Y. Determine the values of the

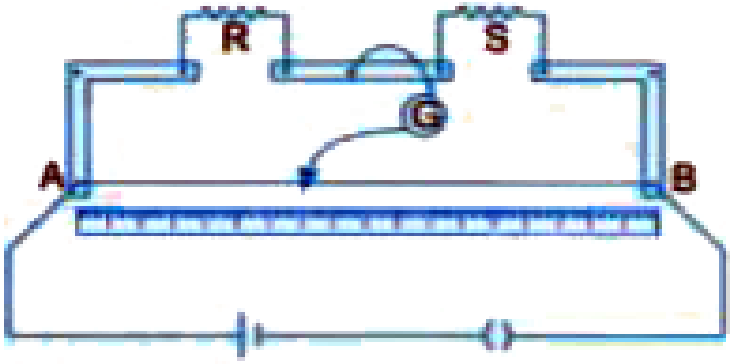
resistances X and Y.



View Text Solution

27. In a metre bridge the null point is found at a distance of 60.0 cm from A. If now a resistance of 5Ω is connected in series with S, the null point occurs at 50 cm. Determine the

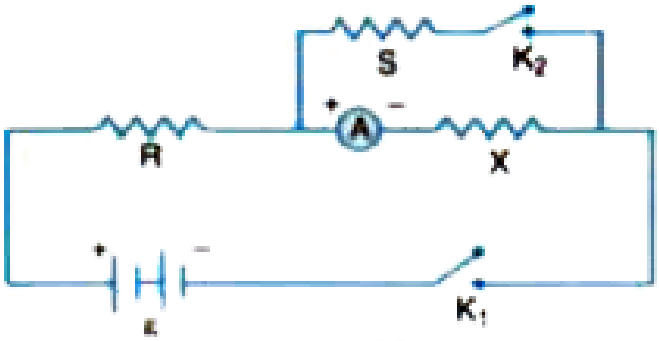
values of R and S.



View Text Solution

28. The reading of an ideal ammeter, in the circuit shown here, equals (i) I when key K_1 is closed but key K_2 is open , (ii) $\frac{I}{2}$ when both keys K_1 and K_2 are closed. Find the expression for the resistance of X in terms of

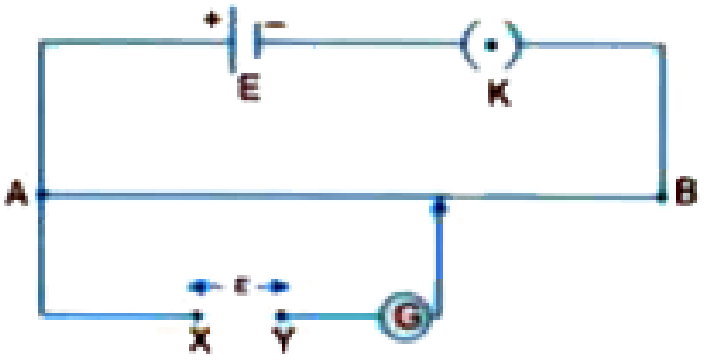
the resistance R and S.



View Text Solution

29. For the potentiometer circuit shown in the given figure, points X and Y represent the two terminals of an unknown emf ε . A student observed that when the jockey is moved from the end A to the end B of the potentiometer

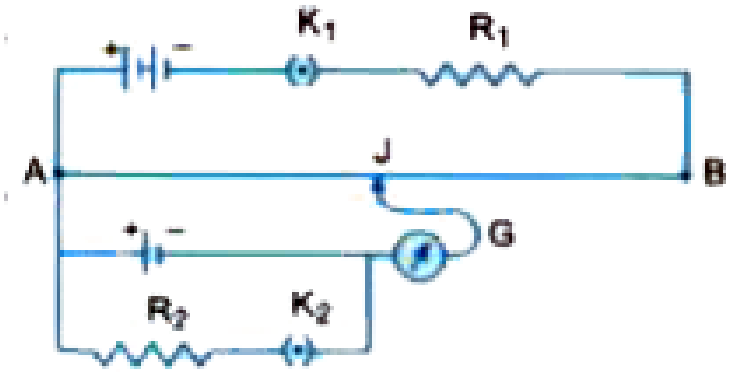
wire, the direction of the deflection in the galvanometer remains in the same direction. What may be the two possible faults in the circuit that could result in this observations ? If the galvanometer deflection at the end B is (i) more, (ii) less, than that at the end A which of the two faults," listed above, would be there in the circuit ? Give reasons in support of your answer in each case.



View Text Solution

30. (a) For the circuit shown in the figure, how would the balancing length be affected, if (i) R_1 is decreased, (ii) R_2 is increased, the other factors remaining the same in the circuit ? Justify your answer in each case.

(b) Why is a potentiometer preferred over a voltmeter ? Give reason.



View Text Solution

31. Two cells of emf 1.5 V and 2 V and internal resistance 1Ω and 2Ω respectively are connected in parallel to pass a current in the same direction through an external resistance of 5Ω.

(i) Draw the circuit diagram.

(ii) Using Kirchhoff's laws, calculate the current through each branch of the circuit and potential difference across the 5Ω resistor.

View Text Solution

32. Calculate the value of the resistance R in the circuit shown in Fig. so that the current in the circuit is 0.2 A. What would be the potential difference between points B and E ?

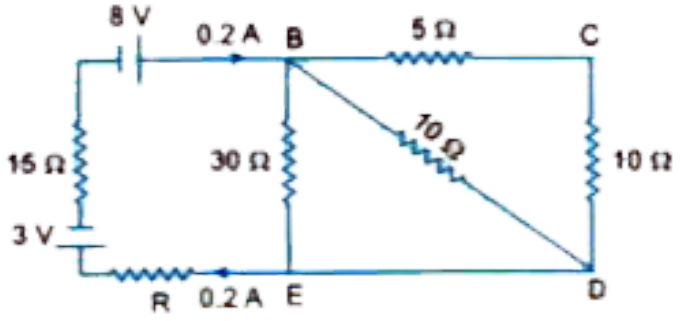
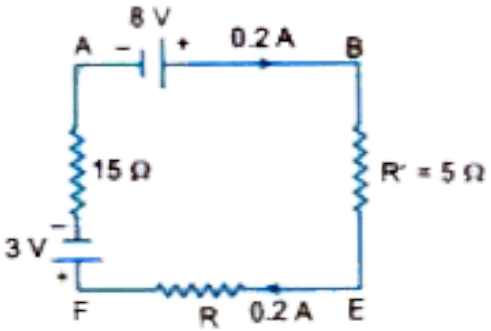
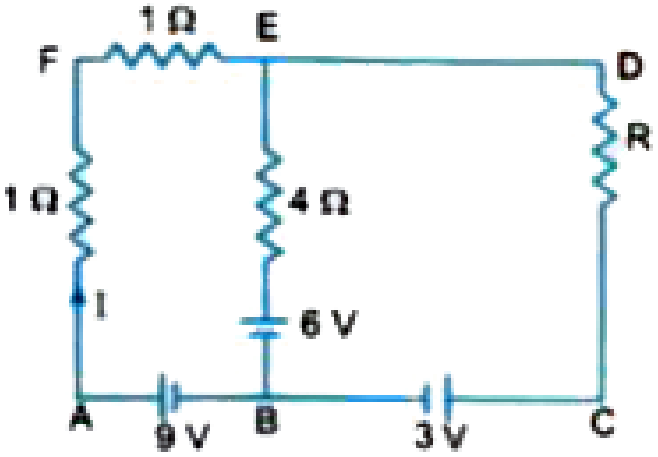


Fig. 3.79



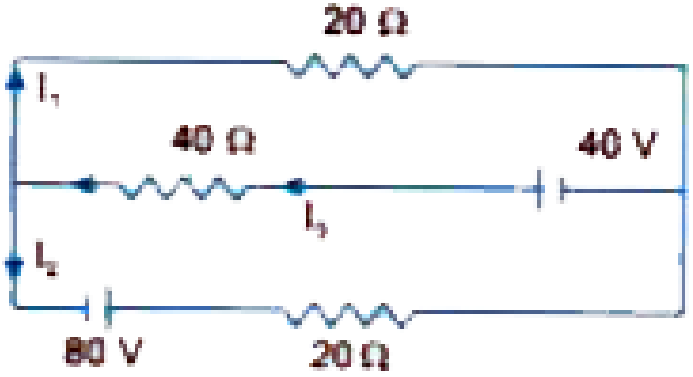
View Text Solution

33. Using Kirchhoff's rules determine the value of unknown resistance R in the circuit so that no current flows through 4 Ω resistance. Also find the potential difference between A and D.



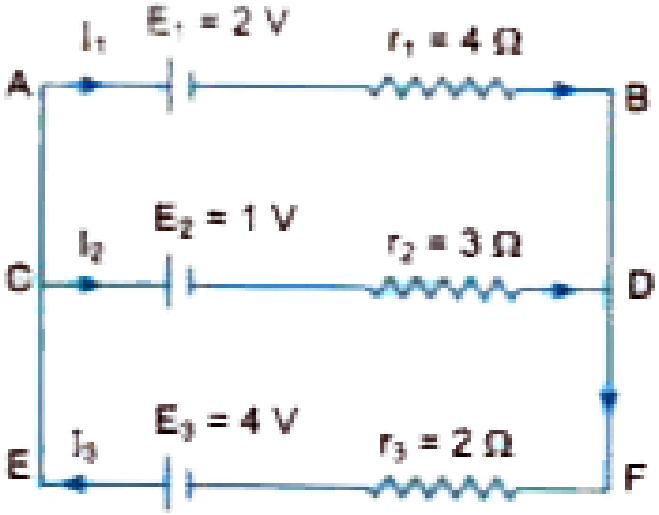
View Text Solution

34. State Kirchhoff's rules of current distribution in an electrical network. Using these rules determine the value of the current I_1 in the electric circuit of Fig.



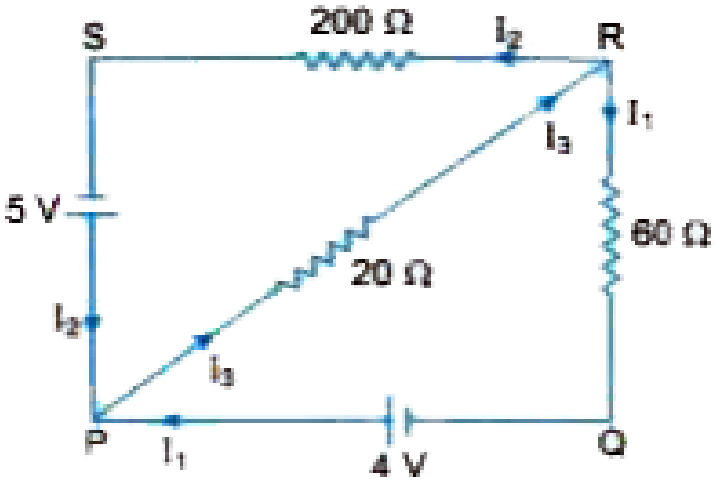
View Text Solution

35. State Kirchhoff's rules. Use these rules to write the expressions for the currents I_1, I_2 and I_3 in the circuit diagram shown in Fig.



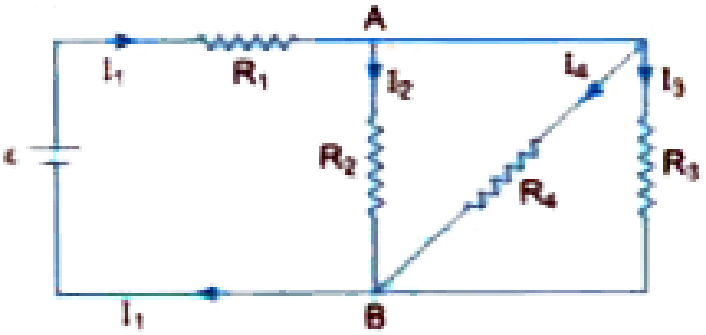
View Text Solution

36. State Kirchhoff's rules. Apply these rules to the loops PRSP and PRQP to write the expressions for the currents I_1, I_2 and I_3 in the given circuit of Fig.



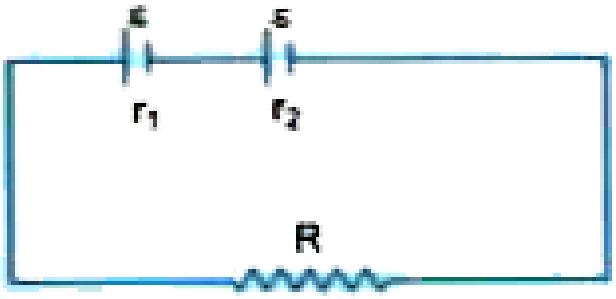
View Text Solution

37. In the circuit shown , $R_1 = 4\Omega, R_2 = R_3 = 15\Omega, R_4 = 30\Omega$ and $\varepsilon = 10V$. Calculate the equivalent resistance of the circuit and the current in each resistor.



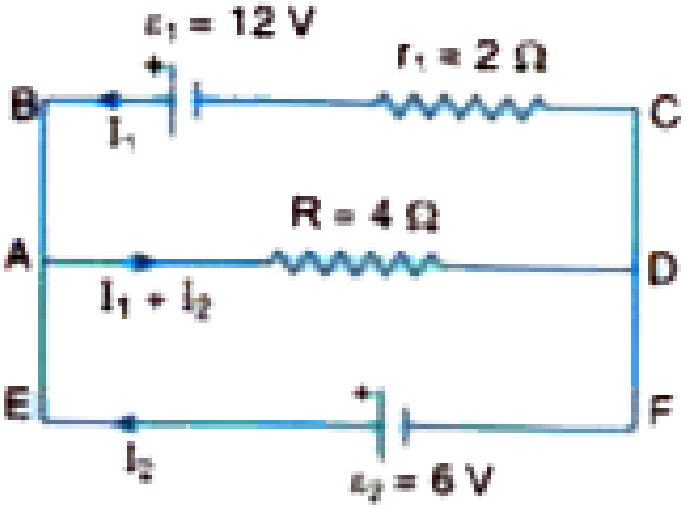
View Text Solution

38. Two cells of same emf ε but internal resistances r_1 and r_2 are connected in series to an external resistor R. What should be the value of R so that the potential difference across the terminals of the first cell becomes zero.



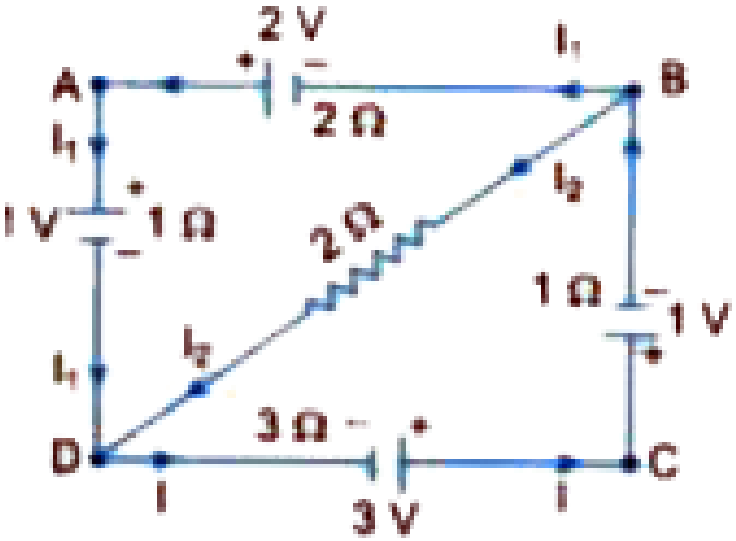
View Text Solution

39. In the electric network shown in the Fig., use Kirchhoff's rules to calculate the power consumed by the resistance $R = 4\Omega$



View Text Solution

40. Using Kirchhoff's rules, calculate the potential difference between B and D in the circuit diagram as shown in Fig.



View Text Solution

41. Two heating elements of resistances R_1 and R_2 when operated at a constant supply of voltage, V, consume powers P_1 and P_2 respectively. Deduce the expressions for the power of their combination when they are, in turn, connected in (i) series and (ii) parallel across the same voltage supply.

View Text Solution

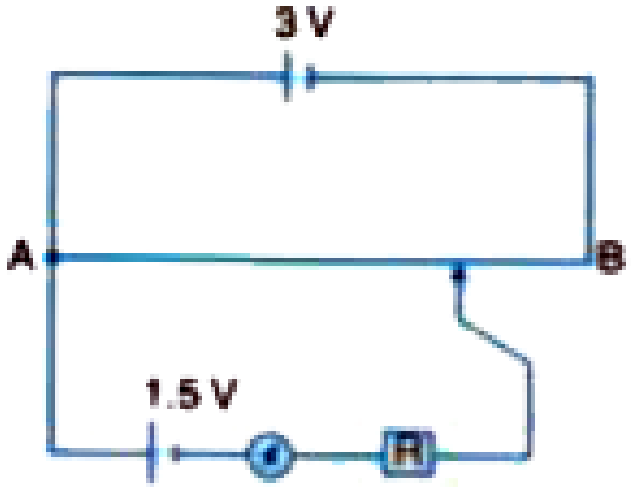
42. A potentiometer wire of length 1 m is connected to a driver cell of emf 3 V as shown in the Fig. When a cell of 1.5 V emf is used in the secondary circuit, the balance point is found to be 60 cm. On replacing this cell and using a cell of unknown emf, the balance point shifts to 80 cm.

(i) Calculate unknown emf of the cell.

(ii) Explain with reason, whether the circuit works, if the driver cell is replaced with a cell of emf 1V.

(iii) Does the high resistance R, used in the

secondary circuit affect the balance point? Justify your answer.



View Text Solution

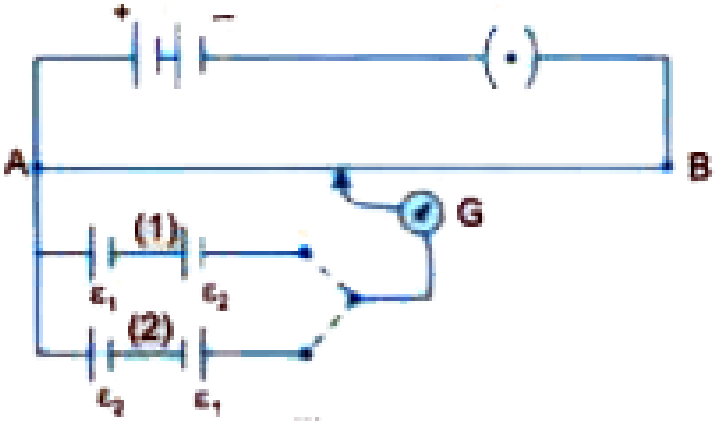
43. A 10 m long wire of uniform cross-section and 20Ω resistance is used in a potentiometer. The wire is connected in series with a battery

of 5 V along with an external resistance of 480 2. If an unknown emf E is balanced at 6.0 m length of the wire, calculate (i) the potential gradient of the potentiometer wire, (ii) the value of unknown emf.

View Text Solution

44. A circuit using a potentiometer and battery of negligible internal resistance is set up as shown in Fig. to develop a constant potential gradient along the wire AB. Two cells

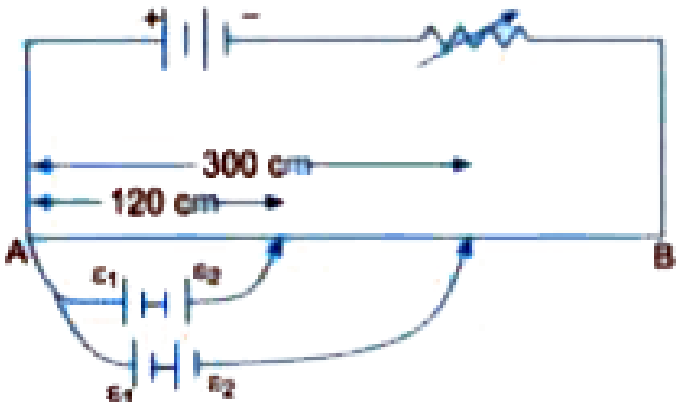
of emfs ε_1 and ε_2 are connected in series as shown in combinations (1) and (2). The balance points are obtained respectively at 400 cm and 240 cm from the point A. Find (i) $\frac{\varepsilon_1}{\varepsilon_2}$, (ii) balancing length for the cell ε_1 only .



View Text Solution

45. In the Fig., a long uniform potentiometer wire AB is having a constant potential gradient along its length. The null points for the two primary cells of emf ε_1 and ε_2 connected in the manner shown are obtained at a distance of 120 cm and 300 cm from the end A. Find $(i)\varepsilon_1/\varepsilon_2$ and (ii) position of null point for the cell ε_1. How is the sensitivity of a

potentiometer increased ?



View Text Solution

46. Two conductors are made of the same material and have the same length. Conductor A is a solid wire of diameter 1 mm. Conductor B is a hollow tube of outer diameter 2 mm and

inner diameter 1 mm. Find the ratio of resistances R_A to R_B

View Text Solution

47. A potentiometer wire of length 1 m has a resistance of 10 Ω . It is connected to a 6 V battery in series with a resistance of 5 Ω . Determine the emf of the primary cell which gives a balance point at 40 cm.

View Text Solution

Long Answer Questions Ii

1. (i) Define the term drift velocity.

(ii) On the basis of electron drift, derive an expression for resistivity of a conductor in terms of number density of free electron and relaxation time. On what factors does resistivity of a conductor depend ?

(iii) Why alloys like constantan and manganin are used for making standard resistors ?

View Text Solution

2. (i) Derive an expression for drift velocity of electrons in a conductor. Hence deduce Ohm's law.

(ii) A wire whose cross-sectional area is increasing linearly from its one end to the other, is connected across a battery of V volts. Which of the following quantities remain constant in the wire ?

(a) drift speed (b) current density (c) electric current (d) electric field

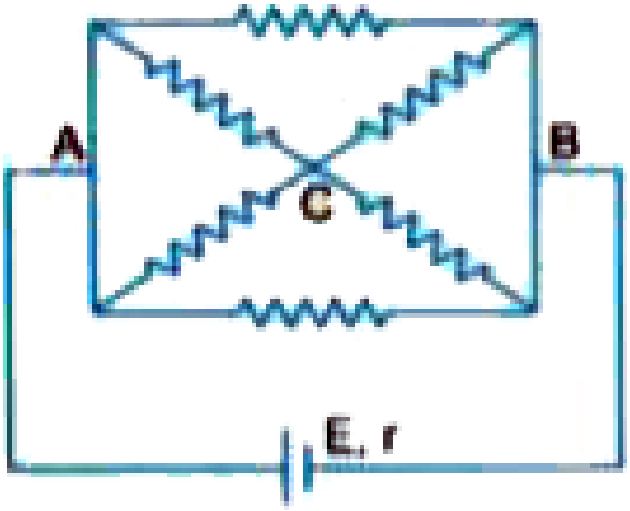
Justify your answer.

View Text Solution

3. (i) State the two Kirchhoff's laws. Explain briefly how these rules are justified.

(ii) The current is drawn from a cell of emf E and internal resistance r connected to the network of resistors each of resistance r as shown in the Fig. Obtain the expression for (a) the current draw from the cell and (b) the

power consumed in the network.

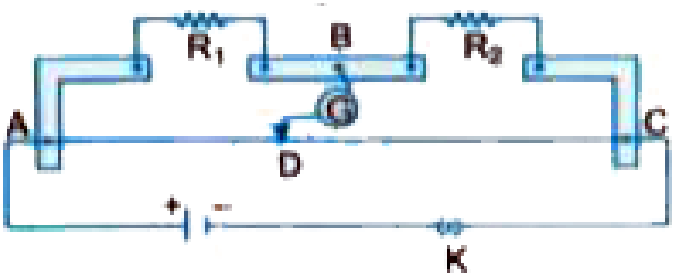


View Text Solution

4. (a) State Kirchhoff's rules for an electric network. Using Krichhoff's rules, obtain the balance condition in terms of the resistances

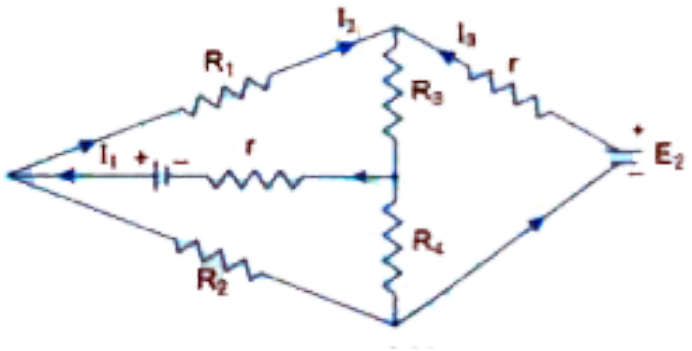
of four arms of Wheatstone bridge,

(b) In the meterbridge experimental set up, shown in the Fig., the null point 'D' is obtained at a distance of 40 cm from end A of the meterbridge wire. If a resistance of 10Ω is connected in series with R_1, null point is obtained at AD = 60 cm. Calculate the values of R_1 and R_2



View Text Solution

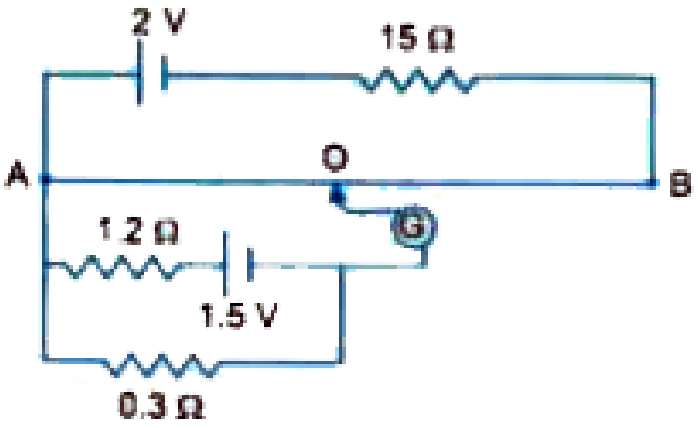
5. State the two rules that serve as general rules for analysis of electrical circuits. Use these rules to write the three equations that may be used to obtain the values of the three unknown currents in the branches (shown) of the circuit



View Text Solution

6. (i) State the principle of working of a potentiometer.

(ii) In the following potentiometer circuit AB is a uniform wire of length 1 m and resistance 10 Ω . Calculate the potential gradient along the wire and balance length AO (= l).



View Text Solution

7. (a) State the working principle of a potentiometer. With the help of the circuit diagram, explain how a potentiometer is used to compare the emfs of two primary cells. Obtain the required expression used for comparing the emfs.

(b) Write two possible causes for one sided deflection in a potentiometer experiment.

View Text Solution

8. (a) State the working principle of a potentiometer with the help of a circuit diagram.

(b) Explain how the internal resistance of a cell is determined. (c) How do the following affect the potentiometer circuit when (i) the internal resistance of the driver cell increases, (ii) the series resistor connected to the driver cell is reduced ? Justify your answer.

View Text Solution

Self Assessment Test Section A Multiple Choice Questions

1. When a piece of aluminium wire of finite length is drawn through a series of dies to reduce its diameter to half its value, its resistance will become

A. 2 times.

B. 4 times.

C. 8 times.

D. 16 times

Answer: D

View Text Solution

2. A carbon resistor has 4 bands of white, brown, red and silver colours respectively. The value of resistance is

A. $(2.2 \pm 10\ \%\ )k\Omega$

B. $(3.3 \pm 5\ \%\ )k\Omega$

C. $(5.6 \pm 10\ \%\ )k\Omega$

D. $(9.1 \pm 10\ \%\ )k\Omega$

Answer: D

View Text Solution

3. A strip of copper and another of germanium are couled from 300 K to 80 K. The resistance of

A. copper as well as germanium strip increases.

B. copper as well as germanium strip decreases.

C. copper strip decreases but that of germanium strip increases.

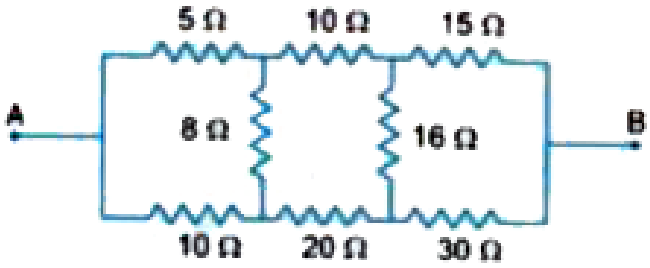
D. copper strip increases but that of germanium strip decreases.

Answer: C

View Text Solution

4. In the arrangement of resistances shown here, the effective resistance between the

points A and B is



A. 20Ω

B. 30Ω

C. 90Ω

D. 110Ω

Answer: A

View Text Solution

5. A battery of 6 volts is connected to the terminals of 3 m long wire of uniform thickness and resistance Fig. of the order of 60 Ω. The difference of potential between two points separated by 50 cm on the wire will be

A. 1V

B. 1.5V

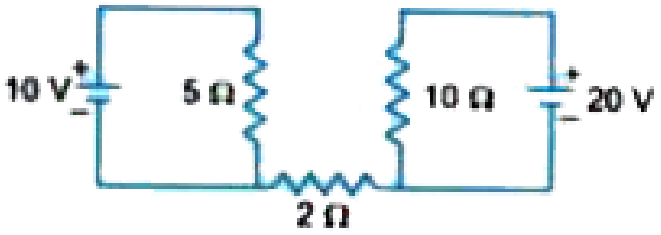
C. 2V

D. 3V

Answer: A

View Text Solution

6. Find out the current flowing through 2Ω resistance in the given circuit.



A. 5A

B. 2A

C. 0

D. 4A

Answer: C

View Text Solution

Self Assessment Test Section A Fill In The Blanks

1. The magnitude of drift velocity per unit electric field is known as ____

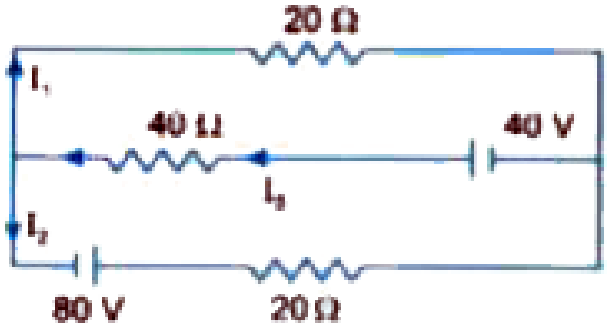
View Text Solution

2. Internal resistance of a cell is _____ proportional to surface area of electrodes immersed into the electrolyte and ____ proportional to the separation between the electrodes.

View Text Solution

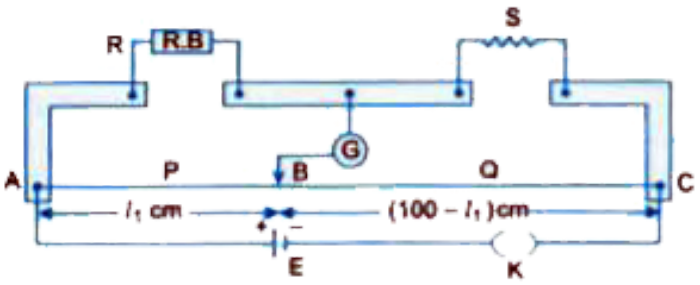
Self Assessment Test Section C

1. State Kirchhoff's rules of current distribution in an electrical network. Using these rules determine the value of the current I_1 in the electric circuit of Fig.



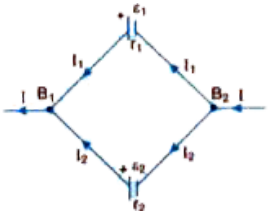
View Text Solution

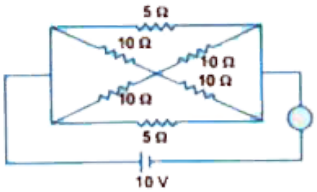
2. What is end error in a metre bridge ? How is it overcome ? The resistances in the two arms of the metre bridge are R=5Ω and S respectively. When the resistance S is shunted with an equal resistance, the new balance length found to be $1.5l_1$, where l_1 is the initial balancing length. Calculate the value of S.



View Text Solution

3. (a) Two cells of emf ε_1 and ε_2 having internal resistances r_1 andr_2 respectively are connected in parallel as shown in Fig. Deduce the expressions for the equivalent emf and equivalent internal resistance of a cell which can replace the combination between the points B_1 and B_2 . (b) Calculate the current shown by the ammeter in the circuit diagram given below





View Text Solution