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Class 12 Physics Chapterwise PYQs

2026 – 2003 | All CBSE Board Papers

Chapter-wise previous year questions, sorted by marks and year

Chapter 3: Current Electricity

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1-Mark Questions (126 questions · Section A · MCQ)

Q1. Two heaters rated as (P_1, V) and (P_2, V) are connected in series across a dc source of V volt. The power consumed by the combination will be:

(A) $(P_1 + P_2)$

(B) $\dfrac{P_1 + P_2}{2}$

(C) $\dfrac{P_1 P_2}{2(P_1 + P_2)}$

(D) $\dfrac{P_1 P_2}{4(P_1 + P_2)}$

[2026 • Set 55-1-1]

Q2. A copper wire is stretched to increase its length by 1%. Then the change in its resistance is close to:

(A) 1%

(B) 4%

(C) -4%

(D) 2%

[2026 • Set 55-1-2]

Q3. A current of 1.5 A is maintained in a copper wire of length 1 m with area of cross-section 1.7×10^{-7} m^2. The magnitude of electric field in the wire is $[\rho_{Cu} = 1.7 \times 10^{-7}\,\Omega\,\text{m}]$:

(A) 0.15 V/m
(B) 0.30 V/m
(C) 1.5 V/m
(D) 3.0 V/m

[2026 • Set 55-1-3]

Q4. Assertion (A): Two electric heaters of power P_1 and P_2 $(> P_1)$ are joined in series across a dc source of voltage V. The power consumed by the combination will be less than that consumed by P_1 when connected across the same source. Reason (R): The power consumed by an electric device when connected to a dc source of voltage V is proportional to its resistance.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false and Reason (R) is also false.

[2026 • Set 55-2-1]

Q5. Assertion (A): In a Wheatstone bridge circuit, if we interchange the position of the cell and the galvanometer, the balance condition $\frac{P}{Q} = \frac{R}{S}$ remains unchanged. Reason (R): $\frac{P}{Q} = \frac{R}{S} \Rightarrow \frac{Q}{S} = \frac{P}{R}$ so balance condition remains same. Select the correct answer from the codes (A), (B), (C) and (D) given below:

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Both Assertion (A) and Reason (R) are false.

[2026 • Set 55-3-1]

Q6. Two wires of same length and same area of cross-section but made of different material of resistivities ρ_1 and ρ_2 are connected in series. The equivalent resistivity of the combination is:

(A) $\frac{1}{2}(\rho_1 + \rho_2)$
(B) $\rho_1 + \rho_2$
(C) $\sqrt{\rho_1 \rho_2}$
(D) $2(\rho_1 + \rho_2)$

[2026 • Set 55-4-1]

Q7. Directions: Questions are Assertion (A) and Reason (R) type. Two statements are given - one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (A), (B), (C) and (D). Assertion (A): The work done, in taking a unit charge around a closed loop of an electric circuit involving cells and resistors in the loop, is zero. Reason (R): The potential at a point depends on the location of the point in the loop. After completing one round, the charge comes back to the point of start.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

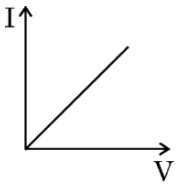
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

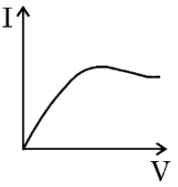
(C) Assertion (A) is true, but Reason (R) is false.

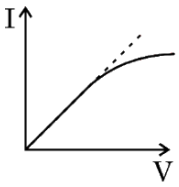
(D) Both Assertion (A) and Reason (R) are false.

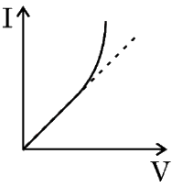
[2026 • Set 55-4-1]

Q8. If resistor X were made of manganin and readings for V and I are taken without switching off the circuit, the graph between V and I will be as:

(A) 

(B) 

(C) 

(D) 

(A) Graph (A)

(B) Graph (B)

(C) Graph (C)

(D) Graph (D)

[2026 • Set 55-4-1]

Q9. Error in the value of X obtained from different sets of voltmeter and ammeter readings, is:

(A) due to error in voltmeter reading only.

(B) due to error in ammeter reading only.

(C) equal to the sum of error in voltmeter reading and error in ammeter reading.

(D) equal to error in voltmeter reading divided by the error in ammeter reading.

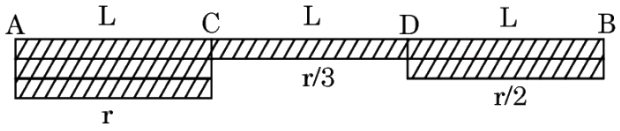
[2026 • Set 55-4-1]

Q10. If the movable end of rheostat is moved towards P, then:

(A) reading in ammeter decreases and reading in voltmeter increases.
(B) readings in both voltmeter and ammeter increase.
(C) reading in ammeter increases and reading in voltmeter decreases.
(D) readings in both voltmeter and ammeter decrease.

[2026 • Set 55-4-1]

Q11. Suppose the unknown resistance X is replaced by a wire made of the same metal. This wire consists of three parts, of the same length L but has radii r, $r/3$ and $r/2$ as shown in the figure.



For a particular setting of the rheostat, let v_1, v_2 and v_3 be the value of drift velocities in parts AC, CD and DB. Then:

(A) $v_1 > v_2 > v_3$
(B) $v_2 > v_3 > v_1$
(C) $v_3 > v_2 > v_1$
(D) $v_1 = v_2 = v_3$

[2026 • Set 55-4-1]

Q12. Consider the same wire, as shown in figure in question (iv) (a) connected in place of X. For a particular setting of rheostat, let E_1, E_2 and E_3 be the value of electric fields in part AC, CD and DB. Then:

(A) $E_1 = E_2 = E_3$
(B) $E_1 > E_2 > E_3$
(C) $E_2 > E_3 > E_1$
(D) $E_2 > E_1 > E_3$

[2026 • Set 55-4-1]

Q13. A wire is gradually stretched to make it 100% longer. Its resistance will increase by:

(A) 100%
(B) 200%
(C) 300%
(D) 400%

[2026 • Set 55-4-2]

Q14. Which of the following characteristics of electrons determines the current in the conductor?

(A) Drift velocity only
(B) Thermal velocity only
(C) Both drift velocity and thermal velocity
(D) Neither drift nor thermal velocity

[2026 • Set 55-4-2]

Q15. Which of the following statements is true about mobility of charge carriers in a metal?
(A) Mobility increases with increase in applied electric field.
(B) Mobility decreases with increase in temperature.
(C) Mobility is independent of the mass of the charge carrier.
(D) Mobility increases with increase in temperature.

[2026 • Set 55-4-3]

Q16. The resistivity ρ of a metal increases with rise in temperature because:
(A) only relaxation time τ of electrons decreases with temperature.
(B) only number of electrons per unit volume 'n' increases appreciably.
(C) τ decreases with temperature but 'n' does not change appreciably.
(D) τ decreases with temperature and 'n' increases.

[2026 • Set 55-4-3]

Q17. Two wires P and Q are made of the same material. The wire Q has twice the diameter and half the length as that of wire P. If the resistance of wire P is R, the resistance of the wire Q will be:
(A) R
(B) $\frac{R}{2}$
(C) $\frac{R}{8}$
(D) $2R$

[2025 • Set 55-1-1]

Q18. The resistance of a wire of length L and radius r is R. Which one of the following would provide a wire of the same material of resistance $\frac{R}{2}$?
(A) Using a wire of same radius and twice the length
(B) Using a wire of same radius and half length
(C) Using a wire of same length and twice the radius
(D) Using a wire of same length and half the radius

[2025 • Set 55-1-2]

Q19. Two conductors A and B of the same material have their lengths in the ratio $1:2$ and radii in the ratio $2:3$. If they are connected in parallel across a battery, the ratio $\frac{v_A}{v_B}$ of the drift velocities of electrons in them will be:

(A) 2
(B) $\frac{1}{2}$
(C) $\frac{8}{9}$
(D) $\frac{9}{8}$

[2025 • Set 55-1-3]

Q20. A student has three resistors, each of resistance R. To obtain a resistance of $\frac{2}{3}R$, she should connect

(A) all the three resistors in series.
(B) all the three resistors in parallel.
(C) two resistors in series and then this combination in parallel with the third resistor.
(D) two resistors in parallel and then this combination in series with the third resistor.

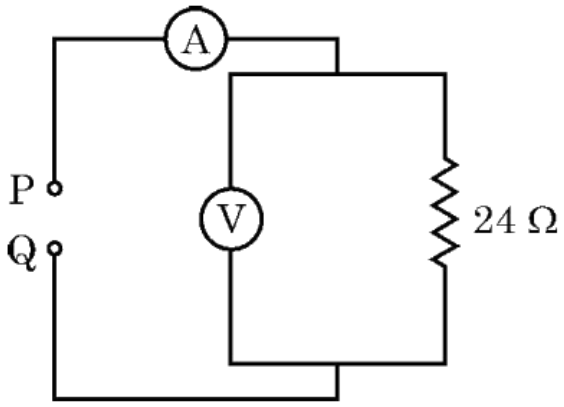
[2025 • Set 55-2-1]

Q21. A battery of e.m.f. 12 V and internal resistance 0.5 Ω is connected to a 9.5 Ω resistor through a key. The ratio of potential difference between the two terminals of the battery, when the key is open to that when the key is closed, is

(A) 1.05
(B) 1
(C) 0.95
(D) 1.1

[2025 • Set 55-2-2]

Q22. Which pair of readings of ideal voltmeter and ideal ammeter in the given circuit is possible when a suitable power source of 3 Ω internal resistance is connected between P and Q?



(A) 12.0 V, 2.0 A
(B) 2.0 V, 0.5 A
(C) 6.0 V, 2.0 A
(D) 12 V, 0.5 A

[2025 • Set 55-2-3]

Q23. A current flows through a cylindrical conductor of radius R. The current density at a point in the conductor is $j = \alpha r$ (along its axis), here α is a constant and r is distance from the axis of the conductor. The current flowing through the portion of the conductor from $r = 0$ to $r = \frac{R}{2}$ is proportional to :

(A) R

(B) R^2

(C) R^3

(D) R^4

[2025 • Set 55-4-1]

Q24. When the switch of the circuit is turned on, the filament of the bulb glows instantaneously because :

(A) the electrons coming from the power source move fast through the initially empty filament.

(B) the filament may be old having low resistance.

(C) electric field is established instantaneously across the filament which pushes the electrons.

(D) free electrons in the filament travel with the speed of light.

[2025 • Set 55-4-2]

Q25. Three wires A, B and C of the same material have lengths and area of cross-sections as $\left(2l, \frac{A}{2}\right)$, (l, A) and $\left(\frac{l}{2}, 2A\right)$, respectively. If the resistances of these wires are R_A, R_B and R_C respectively, then :

(A) $R_A > R_B > R_C$

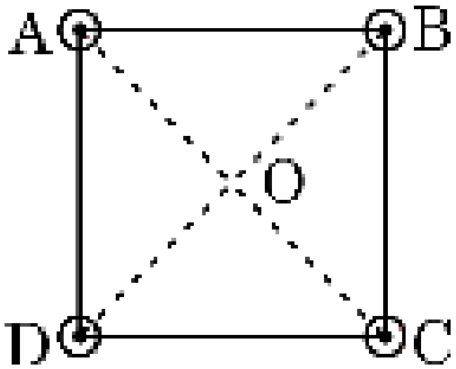
(B) $R_B > R_C > R_A$

(C) $R_B > R_A > R_C$

(D) $R_A > R_C > R_B$

[2025 • Set 55-4-3]

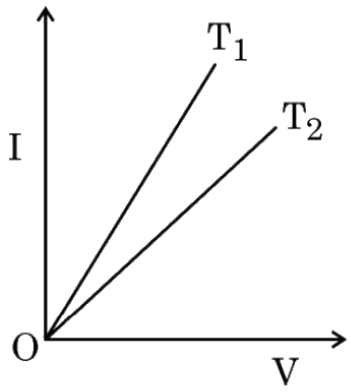
Q26. Four resistors, each of resistance R and a key K are connected as shown in the figure. The equivalent resistance between points A and B when key K is open, will be:



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

[2025 • Set 55-5-1]

Q27. The figure shows the voltage (V) versus the current (I) graphs for a wire at two temperatures T_1 and T_2. One can conclude that:



(A) $T_1 > T_2$
(B) $T_1 < T_2$
(C) $T_1 = T_2/3$
(D) $T_1 < T_2/3$

[2025 • Set 55-6-1]

Q28. If R_s and R_p are the equivalent resistances of n resistors, each of value R, in series and parallel combinations respectively, then the value of $(R_s - R_p)$ is:

(A) $\frac{n^2-1}{n} R$
(B) $\frac{n}{n^2-1} R$
(C) $\left(\frac{n-1}{n}\right)^2 R$
(D) $\frac{(n+1)^2}{n^2} R$

[2025 • Set 55-6-1]

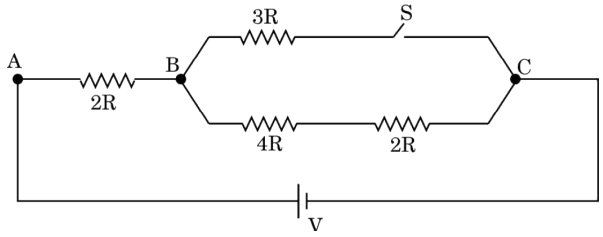
Q29. A wire of resistance R, connected to an ideal battery consumes a power P. If the wire is gradually stretched to double its initial length, and connected across the same battery, the power consumed will be:

(A) $\frac{P}{2}$
(B) $\frac{P}{4}$
(C) P

(D) $2P$

[2025 • Set 55-6-2]

Q30. The ratio of potential difference across AB in the circuit shown for the case (i) when switch S is closed and (ii) when S is open is:



(A) $\frac{1}{4}$
(B) $\frac{1}{2}$
(C) 1
(D) 2

[2025 • Set 55-6-3]

Q31. The effective resistance between points A and B in the given circuit is:

(A) $6\ \Omega$
(B) $5\ \Omega$
(C) $\frac{6}{5}\ \Omega$
(D) $2\ \Omega$

[2025 • Set 55-7-1]

Q32. Case Study: In a metallic conductor, an electron, moving due to thermal motion, suffers collisions with the heavy fixed ions but after collision, it will emerge out with the same speed but in random directions. If we consider all the electrons, their average velocity will be zero. When an electric field is applied, electrons move with an average velocity, known as drift velocity (v_d). The average time between successive collisions is known as relaxation time (τ). The magnitude of drift velocity per unit electric field is called mobility (μ). An expression for current through the conductor can be obtained in terms of drift velocity, number of electrons per unit volume (n), electronic charge ($-e$), and the cross-sectional area (A) of the conductor. This expression leads to an expression between current density ($\vec{J}$) and the electric field ($\vec{E}$). Hence, an expression for resistivity (ρ) of a metal is obtained. This expression helps us to understand increase in resistivity of a metal with increase in its temperature, in terms of change in the relaxation time (τ) and change in the number density of electrons (n). (i) Consider two cylindrical conductors A and B, made of the same metal connected in series to a battery. The length and the radius of B are twice that of A. If μ_A and μ_B are the mobility of electrons in A and B respectively, then $\frac{\mu_A}{\mu_B}$ is:

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

(B) $\frac{1}{4}$
(C) 2
(D) 1

[2025 • Set 55-7-1]

Q33. (ii) A wire of length 0.5 m and cross-sectional area 1.0×10^{-7} m^2 is connected to a battery of 2 V that maintains a current of 1.5 A in it. The conductivity of the material of the wire (in Ω^{-1} m^{-1}) is:

(A) 2.5×10^4
(B) 3.0×10^5
(C) 3.75×10^6
(D) 5.0×10^7

[2025 • Set 55-7-1]

Q34. (iii) The temperature coefficient of resistance of nichrome is 1.70×10^{-4} °C^{-1}. In order to increase resistance of a nichrome wire by 8.5%, the temperature of the wire should be increased by:

(A) 250°C
(B) 500°C
(C) 850°C
(D) 1000°C

[2025 • Set 55-7-1]

Q35. (iv) (a) Consider the contribution of the following two factors I and II in resistivity of a metal: I. Relaxation time of electrons II. Number of electrons per unit volume The resistivity of a metal increases with increase in its temperature because: OR (b) A steady current flows in a copper wire of non-uniform cross-section. Consider the following three physical quantities: I. Electric field II. Current density III. Drift speed Then at the different points along the wire:

(A) (a) I decreases and II increases. OR (b) II and III change, but I is constant.
(B) (a) I increases and II is almost constant. OR (b) I and II change, but III is constant.
(C) (a) Both I and II increase. OR (b) I and III change, but II is constant.
(D) (a) I decreases and II is almost constant. OR (b) All I, II and III change.

[2025 • Set 55-7-1]

Q36. A steady current I is passed through a conductor at room temperature for time t. It is observed that its temperature rises by 0.5°C. If $2I$ current is passed through the conductor (at room temperature) for the same duration, the rise in its temperature will be approximately:

(A) 1.0°C
(B) 1.5°C

(C) 2.0°C
(D) 4.0°C

[2025 • Set 55-7-3]

Q37. Consider the circuit shown in the figure. The potential difference between points A and B is:

(A) $6\,\text{V}$
(B) $8\,\text{V}$
(C) $9\,\text{V}$
(D) $12\,\text{V}$

[2024 • Set 55-1-1]

Q38. A student is asked to connect four cells, each of emf E and internal resistance r, in series. But she/he connects one cell wrongly in series with the other cells. The equivalent emf and the equivalent internal resistance of the combination will be:

(A) $4E$ and $2r$
(B) $4E$ and $3r$
(C) $3E$ and $4r$
(D) $2E$ and $4r$

[2024 • Set 55-1-2]

Q39. In a uniform straight wire, conduction electrons move along $+x$ direction. Let $\vec{E}$ and $\vec{j}$ be the electric field and current density in the wire, respectively. Then:

(A) $\vec{E}$ and $\vec{j}$ both are along $+x$ direction.
(B) $\vec{E}$ and $\vec{j}$ both are along $-x$ direction.
(C) $\vec{E}$ is along $+x$ direction, but $\vec{j}$ is along $-x$ direction.
(D) $\vec{E}$ is along $-x$ direction, but $\vec{j}$ is along $+x$ direction.

[2024 • Set 55-1-3]

Q40. Electrons drift with speed v_d in a conductor with potential difference V across its ends. If V is reduced to $\left(\frac{V}{2}\right)$, their drift speed will become:

(A) $\frac{v_d}{2}$
(B) v_d
(C) $2v_d$
(D) $4v_d$

[2024 • Set 55-2-1]

Q41. When the terminals of a cell are connected to a conductor of resistance R, an electric current flows through the circuit. The electrolyte of the cell also offers some resistance in the path of the current, like the conductor. This resistance offered by the electrolyte is

called internal resistance of the cell (r). It depends upon the nature of the electrolyte, the area of the electrodes immersed in the electrolyte and the temperature. Due to internal resistance, a part of the energy supplied by the cell is wasted in the form of heat. When no current is drawn from the cell, the potential difference between the two electrodes is known as emf of the cell (ε). With a current drawn from the cell, the potential difference between the two electrodes is termed as terminal potential difference (V). Choose the incorrect statement:

(A) The potential difference (V) between the two terminals of a cell in a closed circuit is always less than its emf (ε), during discharge of the cell.

(B) The internal resistance of a cell decreases with the decrease in temperature of the electrolyte.

(C) When current is drawn from the cell then $V = \varepsilon - Ir$.

(D) The graph between potential difference between the two terminals of the cell (V) and the current (I) through it is a straight line with a negative slope.

[2024 • Set 55-2-1]

Q42. Two cells of emfs 2.0 V and 6.0 V and internal resistances $0.1\ \Omega$ and $0.4\ \Omega$ respectively, are connected in parallel. The equivalent emf of the combination will be:

(A) $2.0\ V$

(B) $2.8\ V$

(C) $6.0\ V$

(D) $8.0\ V$

[2024 • Set 55-2-1]

Q43. Dipped in the solution, the electrode exchanges charges with the electrolyte. The positive electrode develops a potential V_+ $(V_+ > 0)$, and the negative electrode develops a potential $-(V_-)$ $(V_- > 0)$, relative to the electrolyte adjacent to it. When no current is drawn from the cell then:

(A) $\varepsilon = V_+ + V_- > 0$

(B) $\varepsilon = V_+ - V_- > 0$

(C) $\varepsilon = V_+ + V_- < 0$

(D) $\varepsilon = V_+ + V_- = 0$

[2024 • Set 55-2-1]

Q44. (a) Five identical cells, each of emf 2 V and internal resistance $0.1\ \Omega$ are connected in parallel. This combination in turn is connected to an external resistor of $9.98\ \Omega$. The current flowing through the resistor is: OR (b) Potential difference across a cell in the open circuit is 6 V. It becomes 4 V when a current of 2 A is drawn from it. The internal resistance of the cell is:

(A) (a) $0.05\ A$ (b) $1.0\ \Omega$

(B) (a) $0.1\ A$ (b) $1.5\ \Omega$

(C) (a) $0.15\ A$ (b) $2.0\ \Omega$
(D) (a) $0.2\ A$ (b) $2.5\ \Omega$

[2024 • Set 55-2-1]

Q45. Assertion (A): When electrons drift in a conductor, it does not mean that all free electrons in the conductor are moving in the same direction. Reason (R): The drift velocity is superposed over large random velocities of electrons.

(A) If both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) If both Assertion (A) and Reason (R) are true and Reason (R) is not the correct explanation of Assertion (A).
(C) If Assertion (A) is true and Reason (R) is false.
(D) If both Assertion (A) and Reason (R) are false.

[2024 • Set 55-4-1]

Q46. A battery supplies $0.9\,\text{A}$ current through a $2\,\Omega$ resistor and $0.3\,\text{A}$ current through a $7\,\Omega$ resistor when connected one by one. The internal resistance of the battery is:

(A) $2\,\Omega$
(B) $1.2\,\Omega$
(C) $1\,\Omega$
(D) $0.5\,\Omega$

[2024 • Set 55-5-1]

Q47. An ammeter and a voltmeter are connected in series to a battery. Their readings are noted as 'A' and 'V' respectively. If a resistor is connected in parallel with the voltmeter, then:

(A) A will increase, V will decrease.
(B) A will decrease, V will increase.
(C) Both A and V will decrease.
(D) Both A and V will increase.

[2024 • Set 55-5-2]

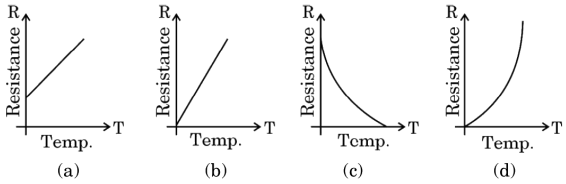
Q48. A heater coil rated as $(P,\ V)$ is cut into two equal parts. One of the parts is then connected to a battery of V volt. The power consumed by it will be:

(A) P
(B) $\dfrac{P}{2}$
(C) $\dfrac{P}{4}$
(D) $2P$

[2024 • Set 55-5-3]

Q49. For a metallic conductor, the correct representation of variation of resistance R with

temperature T is:



(A) Graph (a)
(B) Graph (b)
(C) Graph (c)
(D) Graph (d)

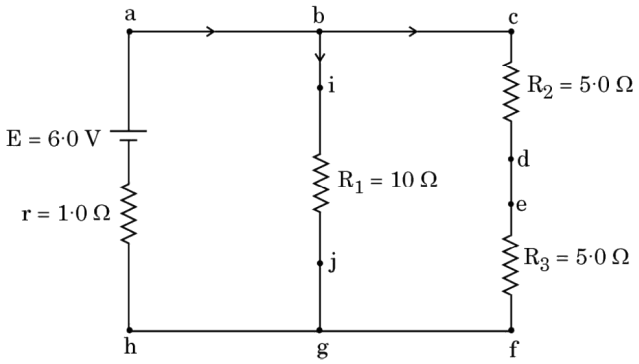
[2023 • Set 55-1-1]

Q50. The potential difference across a cell in an open circuit is 8 V. It falls to 4 V when a current of 4 A is drawn from it. The internal resistance of the cell is:

(A) $4\,\Omega$
(B) $8\,\Omega$
(C) $2\,\Omega$
(D) $1\,\Omega$

[2023 • Set 55-1-1]

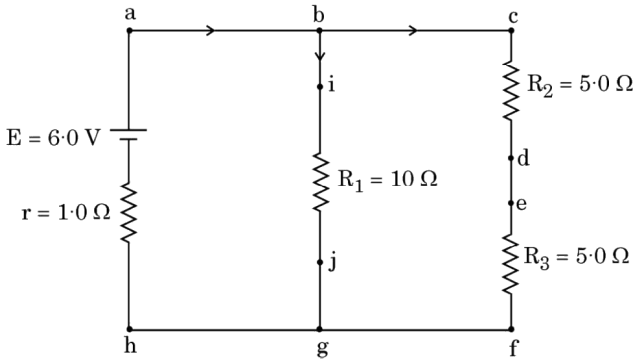
Q51. The following figure shows a circuit diagram. We can find the currents through and potential differences across different resistors using Kirchhoff's rules.



Answer the following questions based on the above: Which points are at the same potential in the circuit?

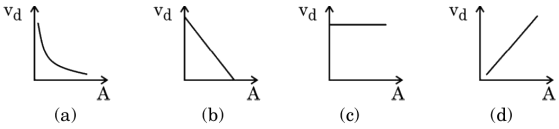
[2023 • Set 55-1-1]

Q52. Refer to the circuit diagram. What is the current through arm bg?



[2023 • Set 55-1-1]

Q53. A steady current flows through a metallic wire whose area of cross-section (A) increases continuously from one end of the wire to the other. The magnitude of drift velocity (v_d) of the free electrons as a function of 'A' can be shown by:



(A) Graph (a)
(B) Graph (b)
(C) Graph (c)
(D) Graph (d)

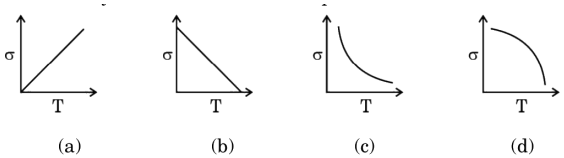
[2023 • Set 55-1-1]

Q54. The masses of two cylindrical wires of copper are in the ratio of $1 : 3$ and their lengths are in the ratio of $5 : 3$. The ratio of their resistances will be:

(A) $1 : 8$
(B) $2 : 5$
(C) $2 : 3$
(D) $3 : 5$

[2023 • Set 55-1-2]

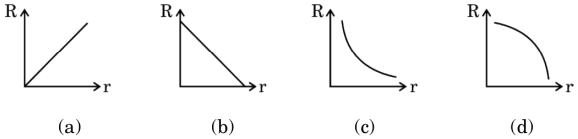
Q55. Which one of the following is the correct representation of variation of conductivity of a conductor with temperature?



(A) Graph (a)
(B) Graph (b)
(C) Graph (c)
(D) Graph (d)

[2023 • Set 55-1-2]

Q56. The correct graph showing the variation of the resistance (R) of a cylindrical metal wire as a function of its radius (r), keeping its length and temperature constant, is:



(A) Graph (a)
(B) Graph (b)
(C) Graph (c)
(D) Graph (d)

[2023 • Set 55-1-3]

Q57. The number of electrons flowing through a conductor per second is 3.3×10^{19}. The current flowing through the conductor is:

(A) 2.0 A
(B) 3.3 A
(C) 4.8 A
(D) 5.3 A

[2023 • Set 55-1-3]

Q58. A current of 0.8 A flows in a conductor of $40\ \Omega$ for 1 minute. The heat produced in the conductor will be

(A) 1445 J
(B) 1536 J
(C) 1569 J
(D) 1640 J

[2023 • Set 55-2-1]

Q59. A cell of emf E is connected across an external resistance R. When current I is drawn from the cell, the potential difference across the electrodes of the cell drops to V. The internal resistance 'r' of the cell is

(A) $\left(\frac{E-V}{V}\right)R$
(B) $\left(\frac{E-V}{E}\right)R$
(C) $\frac{E-V}{I}$
(D) $\left(\frac{E-V}{I}\right)r$

[2023 • Set 55-2-1]

Q60. A steady current of 8 mA flows through a wire. The number of electrons passing through a cross-section of the wire in 10 s is

(A) 4.0×10^{16}
(B) 5.0×10^{17}
(C) 1.6×10^{16}
(D) 1.0×10^{17}

[2023 • Set 55-2-2]

Q61. A conductor of $10\ \Omega$ is connected across a 6 V ideal source. The power supplied by the source to the conductor is

(A) 1.8 W
(B) 2.4 W
(C) 3.6 W
(D) 7.2 W

[2023 • Set 55-2-2]

Q62. The current in a device varies with time t as $I = 6t$, where I is in mA and t is in s. The amount of charge that passes through the device during $t = 0$ s to $t = 3$ s is

(A) 10 mC
(B) 18 mC
(C) 27 mC
(D) 54 mC

[2023 • Set 55-2-3]

Q63. Assertion (A): The internal resistance of a cell is constant. Reason (R): Ionic concentration of the electrolyte remains same during use of a cell.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false and Reason (R) is also false.

[2023 • Set 55-3-1]

Q64. The current density due to drift of electrons in a conductor is given by (symbols have their usual meanings):

(A) $neAv_d$
(B) $\dfrac{neA}{v_d}$
(C) $\dfrac{ne}{v_d}$
(D) nev_d

[2023 • Set 55-3-1]

Q65. The emf and internal resistance of a cell are E and r respectively. It is connected across an external resistance $R = 2r$. The potential drop across the terminals of the cell will be:

(A) $\frac{E}{3}$
(B) $\frac{E}{2}$
(C) $\frac{2E}{3}$
(D) E

[2023 • Set 55-3-2]

Q66. The SI unit of mobility of charge carriers is:

(A) $\Omega\,s^{-1}$
(B) $m^2V^{-1}s^{-1}$
(C) $m\ s^{-1}V^{-1}$
(D) $\Omega\,m$

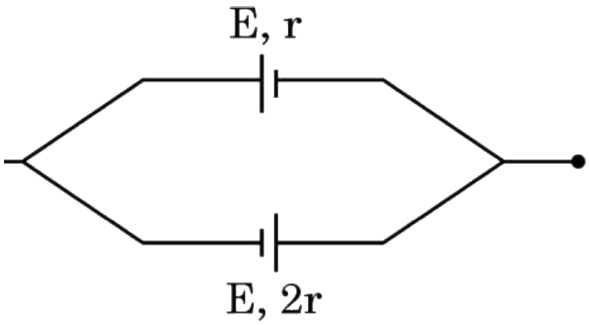
[2023 • Set 55-3-2]

Q67. A battery of emf E and internal resistance r is connected to an external circuit. The potential drop within the battery is proportional to:

(A) current in the circuit
(B) total resistance of the circuit
(C) emf of the battery
(D) power dissipated in the circuit

[2023 • Set 55-3-3]

Q68. Two cells of emf E each and internal resistances r and $2r$ are connected in parallel as shown in the figure. The equivalent emf of the combination is:



(A) zero
(B) $\frac{E}{2}$
(C) $\frac{3E}{2}$
(D) E

[2023 • Set 55-3-3]

Q69. Two wires of equal length and radii r and $2r$ are connected in series. Their resistivities are 2ρ and ρ respectively. For the same current passing through the combination, the potential drop across their ends will be in the ratio of:

(A) $2:1$
(B) $1:2$
(C) $4:1$
(D) $8:1$

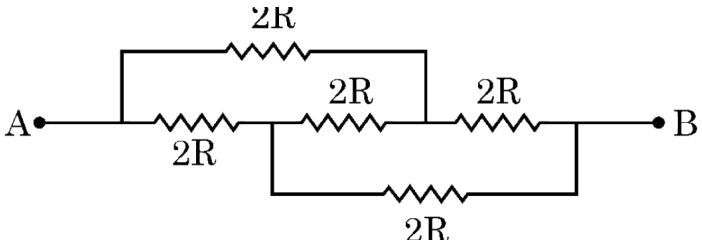
[2023 • Set 55-3-3]

Q70. Assertion (A): When three electric bulbs of power 200 W, 100 W and 50 W are connected in series to a source, the power consumed by the 50 W bulb is maximum. Reason (R): In a series circuit, current is the same through each bulb, but the potential difference across each bulb is different.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false and Reason (R) is also false.

[2023 • Set 55-4-1]

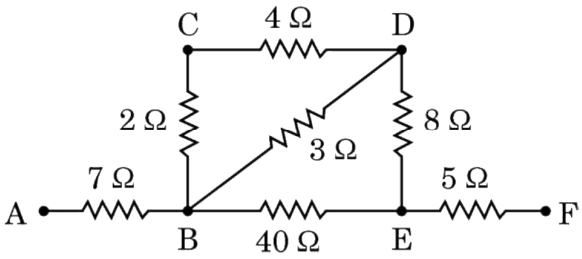
Q71. Assertion (A): The equivalent resistance between points A and B in the given network is 2R. Reason (R): All the resistors are connected in parallel.



(A) Both Assertion (A) and Reason (R) are true and (R) is the correct explanation of (A).
(B) Both Assertion (A) and Reason (R) are true and (R) is NOT the correct explanation of (A).
(C) Assertion (A) is true and Reason (R) is false.
(D) Assertion (A) is false and Reason (R) is also false.

[2023 • Set 55-5-1]

Q72. Assertion (A): The given figure does not show a balanced Wheatstone bridge. Reason (R): For a balanced bridge small current should flow through the galvanometer.



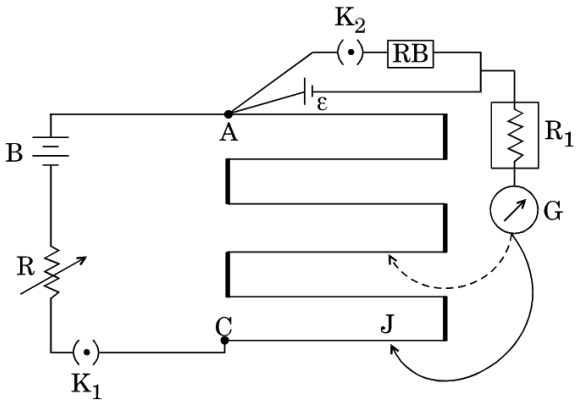
(A) Both Assertion (A) and Reason (R) are true and (R) is the correct explanation of (A).
(B) Both Assertion (A) and Reason (R) are true and (R) is NOT the correct explanation of (A).
(C) Assertion (A) is true and Reason (R) is false.
(D) Assertion (A) is false and Reason (R) is also false.

[2023 • Set 55-5-3]

Q73. Two wires X and Y of the same material and of equal lengths having area of cross-section A and $2A$ respectively, are connected in parallel across an ideal battery of emf E. What is the ratio of current density (J_X/J_Y) in them?

[2021]

Q74. A potentiometer draws a steady current from the battery (B) of emf E in the circuit as shown in the figure. The balancing length for the cell of emf ε when key K_2 is kept open, is ℓ_1. If key K_2 is closed and a resistance S is introduced in the resistance box (RB), the balancing length becomes ℓ_2.



The balancing length $\ell_1 > \ell_2$ because (A) $E > \varepsilon$. (B) positive terminal of the battery is connected to positive terminal of the cell. (C) the voltage drop across the cell is greater than that across the battery. (D) terminal potential difference of the cell is less than its emf.

[2021]

Q75. The high resistance R_1 in the circuit is used to (A) keep the balance point near the mid-point of the potentiometer wire AC. (B) reduce the current supplied by the battery (B) to zero at balance point. (C) protect the galvanometer from damage due to large

current. (D) make the galvanometer more sensitive.

[2021]

Q76. If the key K_2 is kept open and resistance R_1 is increased, the balancing length ℓ_1 of the wire will (A) increase. (B) decrease. (C) remain unaffected. (D) become zero.

[2021]

Q77. Two potentiometers P and Q use the same wire of lengths $5\,\text{m}$ and $10\,\text{m}$ respectively, between A and C. They are connected to battery (B) in the circuit separately. The potentiometer which is preferred to compare the emfs of two cells is (A) P, because potential gradient is less. (B) Q, because potential gradient is less. (C) P, because current is more. (D) Q, because resistance of the potentiometer is less.

[2021]

Q78. The reason for preferring manganin wire in a potentiometer is because (A) of high value of its temperature coefficient of resistivity. (B) of its low resistivity. (C) of low value of its temperature coefficient of resistivity. (D) its resistance decreases with increase in temperature.

[2021]

Q79. A potentiometer can measure emf of a cell because

(A) the sensitivity of potentiometer is large.
(B) no current is drawn from the cell at balance.
(C) no current flows in the wire of potentiometer at balance.
(D) internal resistance of cell is neglected.

[2020 • Set 55-1-1]

Q80. Two resistors R_1 and R_2 of $4\,\Omega$ and $6\,\Omega$ are connected in parallel across a battery. The ratio of power dissipated in them, $P_1 : P_2$ will be

(A) $4 : 9$
(B) $3 : 2$
(C) $9 : 4$
(D) $2 : 3$

[2020 • Set 55-1-1]

Q81. Kirchhoff's first rule at a junction in an electrical network, deals with conservation of

(A) energy
(B) charge
(C) momentum
(D) both energy and charge

[2020 • Set 55-1-2]

Q82. The resistance of a metal wire increases with increasing temperature on account of

(A) decrease in free electron density.
(B) decrease in relaxation time.
(C) increase in mean free path.
(D) increase in the mass of electron.

[2020 • Set 55-1-2]

Q83. Two unequal resistors are connected in series across a battery. Then the

(A) potential difference across each resistor is the same.
(B) current in the smaller resistor is larger.
(C) potential difference across the bigger resistor is greater.
(D) power dissipated in both resistors is the same.

[2020 • Set 55-1-3]

Q84. A cell of internal resistance r connected across an external resistance R can supply maximum current when

(A) $R = r$
(B) $R \gg r$
(C) $R = \frac{r}{2}$
(D) $R = 0$

[2020 • Set 55-2-1]

Q85. In a current carrying conductor, the ratio of the electric field and the current density at a point is called

(A) Resistivity
(B) Conductivity
(C) Resistance
(D) Mobility

[2020 • Set 55-2-1]

Q86. Resistivity of a given conductor depends upon

(A) temperature.
(B) length of conductor.
(C) area of cross-section.
(D) shape of the conductor.

[2020 • Set 55-2-2]

Q87. The ratio of current density and electric field is called

(A) Resistivity
(B) Conductivity

(C) Drift velocity
(D) Mobility

[2020 • Set 55-2-2]

Q88. For a fixed potential difference applied across a conductor, the drift speed of free electrons does not depend upon
(A) free electron density in the conductor.
(B) mass of the electrons.
(C) length of the conductor.
(D) temperature of the conductor.

[2020 • Set 55-2-3]

Q89. The electrical resistance of a conductor
(A) varies directly proportional to its area of cross-section.
(B) decreases with increase in its temperature.
(C) decreases with increase in its conductivity.
(D) is independent of its shape but depends only on its volume.

[2020 • Set 55-3-1]

Q90. $m^2\,V^{-1}\,s^{-1}$ is the SI unit of which of the following?
(A) Drift velocity
(B) Mobility
(C) Resistivity
(D) Potential gradient

[2020 • Set 55-3-1]

Q91. The element of a heater is rated (P, V). If it is connected across a source of voltage $\frac{V}{2}$, then the power consumed by it will be
(A) P
(B) $2P$
(C) $\frac{P}{2}$
(D) $\frac{P}{4}$

[2020 • Set 55-3-1]

Q92. n resistors, each of resistance R are connected (a) in series, and (b) in parallel. Each combination is then connected to a source of emf E. The ratio of heat produced per second in the two cases will be
(A) $n : 1$
(B) $1 : n$

(C) $n^2 : 1$

(D) $1 : n^2$

[2020 • Set 55-3-2]

Q93. A uniform wire of $16\,\Omega$ resistance is bent round in the form of a circle. When connected in a circuit between its two diametrically opposite points, its effective resistance will be

(A) $8\,\Omega$

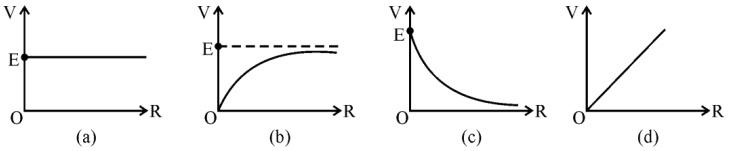
(B) $16\,\Omega$

(C) $4\,\Omega$

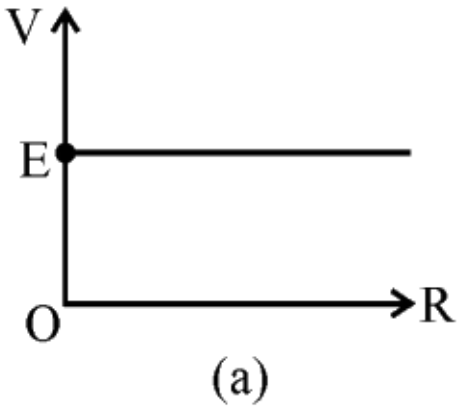
(D) $2\,\Omega$

[2020 • Set 55-3-3]

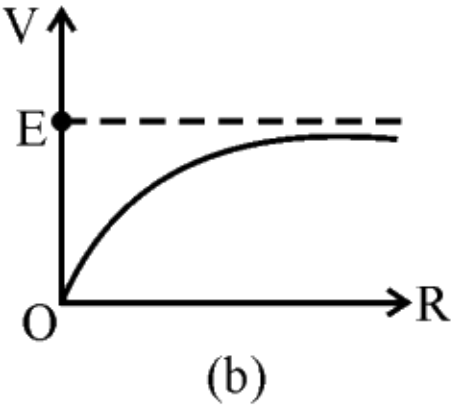
Q94. A cell of emf (E) and internal resistance r is connected across a variable external resistance R. The graph of terminal potential difference V as a function of R is —



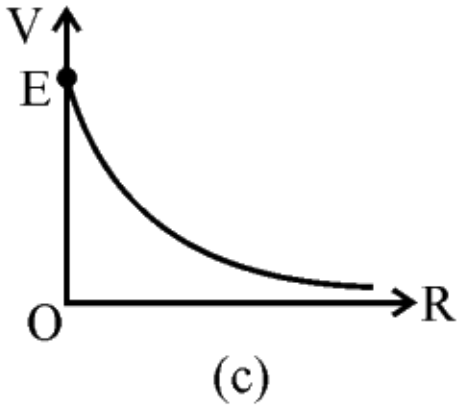
(A)



(B)

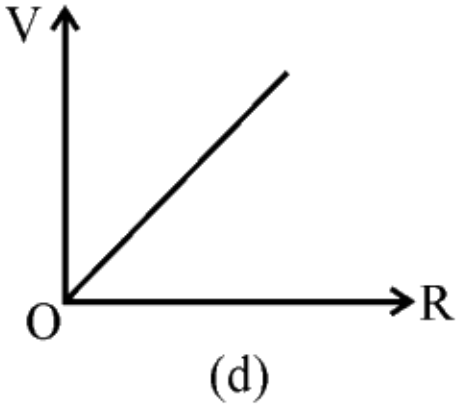


(C)



(c)

(D)



(d)

[2020 • Set 55-4-1]

Q95. Fill in the blank with appropriate answer. To minimize the percentage error in the determination of unknown resistance of a conductor in meter bridge experiment, the balance point is adjusted near _____ of the wire.

OR

In potentiometer, a long uniform wire is used to _____ potential gradient along the wire.

[2020 • Set 55-4-1]

Q96. A copper wire of non-uniform area of cross-section is connected to a d.c. battery. The physical quantity which remains constant along the wire is _____ .

[2020 • Set 55-5-1]

Q97. 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?

[2019 • Set 55-1-1]

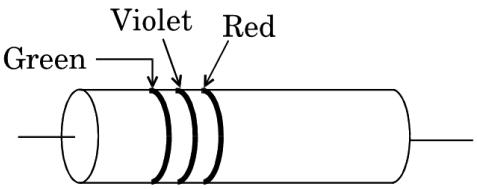
Q98. When a potential difference is applied across the ends of a conductor, how is the drift velocity of the electrons related to the relaxation time?

[2019 • Set 55-1-2]

Q99. How is the drift velocity in a conductor affected with the rise in temperature?

[2019 • Set 55-1-3]

Q100. A carbon resistor is shown in the figure. Using colour code, write the value of the resistance.



[2019 • Set 55-3-1]

Q101. Draw a plot of resistivity of copper as a function of temperature.

[2019 • Set 55-3-3]

Q102. Under what condition will the current in a wire be the same when connected in series and in parallel of n identical cells each having internal resistance r and external resistance R?

[2019 • Set 55-4-1]

Q103. Why is the terminal voltage of a cell generally less than the emf of the cell?

[2019 • Set 55-4-2]

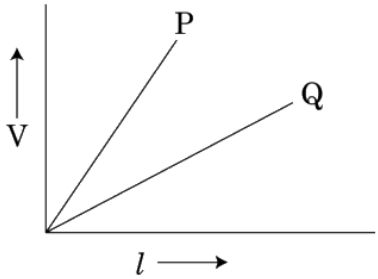
Q104. Name the charge carriers for the flow of current in a (i) conductor and (ii) electrolyte.

[2019 • Set 55-4-3]

Q105. 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.

[2017]

Q106. The variation of potential difference V with length l in case of two potentiometer wires P and Q is as shown. Which one of these will you prefer for comparing emfs of two primary cells and why?



[2016]

Q107. Define the term conductivity of a conductor. On what factors does it depend?

[2016]

Q108. Define mobility of a charge carrier. What is its relation with relaxation time?

[2016]

Q109. Two wires one of copper and other of manganin have same resistance and equal length. Which wire is thicker and why?

[2016]

Q110. Define the term 'relaxation time' in a conductor.

[2016]

Q111. Distinguish between emf and terminal voltage of a cell.

[2015]

Q112. Define the term 'Mobility' of charge carriers in a conductor. Write its S.I. unit.

[2014]

Q113. Show variation of resistivity of copper as a function of temperature in a graph.

[2014]

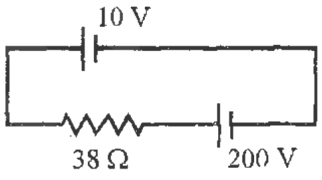
Q114. Define the term 'electrical conductivity' of a metallic wire. Write its S.I. unit.

[2014]

Q115. Define the term 'drift velocity' of charge carriers in a conductor and write its relationship with the current flowing through it.

[2014]

Q116. A 10 V battery of negligible internal resistance is connected across a 200 V battery and a resistance of $38\,\Omega$ as shown in the figure. Find the value of the current in circuit.



[2013]

Q117. The emf of a cell is always greater than its terminal voltage. Why? Give reason.

[2013]

Q118. 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.

[2012]

Q119. Two wires of equal length, one of copper and the other of manganin have the same resistance. Which wire is thicker?

[2012]

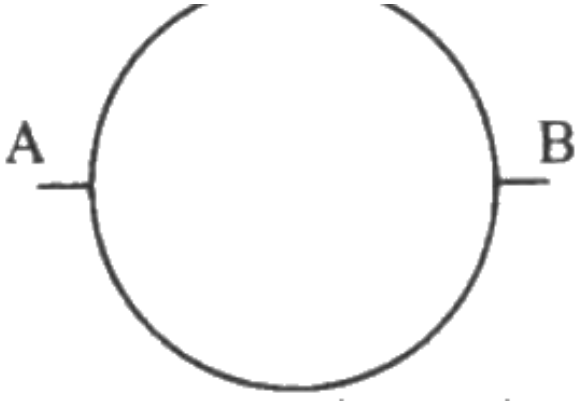
Q120. When electrons drift in a metal from lower to higher potential, does it mean that all the free electrons of the metal are moving in the same direction?

[2012]

Q121. A resistance R is connected across a cell of emf ε and internal resistance r. A potentiometer now measures the potential difference between the terminals of the cell as V. Write the expression for r in terms of ε, V and R.

[2011 • Set 55-1-1]

Q122. 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?



[2010]

Q123. The plot of the variation of potential difference across a combination of three identical cells in series, versus current is as shown below. What is the emf of each cell?

[2008]

Q124. Sketch a graph showing variation of resistivity of carbon with temperature.

[2006]

Q125. Define electrical conductivity of a conductor and give its S.I. unit.

[2003]

Q126. What happens to the power dissipation if the value of electric current passing through a

conductor of constant resistance is doubled?

[2003]

2-Mark Questions (84 questions · Section B · VSA)

Q1. What is the order of magnitude of drift velocity of electrons in a conductor? Deduce the relation between the current flowing through a conductor and drift velocity of electrons in it.

[2026 • Set 55-1-1]

Q2. A heating element using nichrome is connected to a 220 V supply. Initially it draws a current of $2{\cdot}9$ A. After some time, the current attains a steady value of $2{\cdot}5$ A. Find the steady temperature of the heating element if the room temperature is $27\,^\circ$C. The temperature coefficient of resistance of nichrome is $1{\cdot}7 \times 10^{-4}\,^\circ\text{C}^{-1}$.

[2026 • Set 55-2-1]

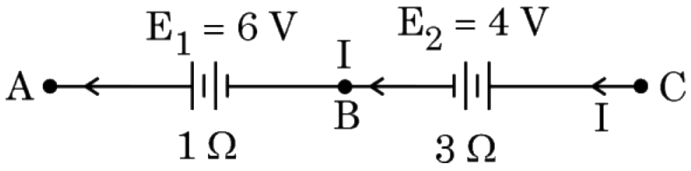
Q3. Calculate the temperature at which the resistance of a conductor becomes 20% more than its resistance at $27\,^\circ$C. The value of the temperature coefficient of resistance of the material of conductor is $2{\cdot}0 \times 10^{-4}\,^\circ\text{C}^{-1}$.

[2026 • Set 55-2-2]

Q4. (a) Why is manganin used in wire-wound standard resistors? Calculate the temperature at which the resistance of a wire increases by 25% of its resistance at room temperature $27{\cdot}5\,^\circ$C. The temperature coefficient of resistance of the material of the wire is $0{\cdot}004\,^\circ\text{C}^{-1}$.

[2026 • Set 55-2-3]

Q5. In the given figure, a steady current I flows through the circuit when points A and C are connected by a wire of negligible resistance. Find the potential difference between points B and C.



[2026 • Set 55-3-1]

Q6. A battery of emf 21 V and internal resistance $3\ \Omega$ is connected to a resistor. If the current in the circuit is 3 A, find:

(i) the resistance of the resistor.

(ii) the terminal voltage of the battery.

[2026 • Set 55-3-1]

Q7. An electric iron rated $2.2\,\text{kW}$, $220\,\text{V}$ is operated at $110\,\text{V}$ supply. Find:

(i) its resistance, and

(ii) heat produced by it in 10 minutes.

[2026 • Set 55-5-1]

Q8. A current of $4.0\,\text{A}$ flows through a wire of length $1\,\text{m}$ and cross-sectional area $1.0\,\text{mm}^2$, when potential difference of $2\,\text{V}$ is applied across its ends. Calculate the resistivity of the material of the wire.

[2026 • Set 55-5-1]

Q9. A battery of emf E and internal resistance r is connected to a rheostat. When a current of $2\,\text{A}$ is drawn from the battery, the potential difference across the rheostat is $5\,\text{V}$. The potential difference becomes $4\,\text{V}$ when a current of $4\,\text{A}$ is drawn from the battery. Calculate the value of E and r.

[2025 • Set 55-1-1]

Q10. Show that $\vec{E} = \rho\,\vec{j}$ leads to Ohm's law. Write a condition in which the Ohm's law is not valid for a material.

[2025 • Set 55-1-2]

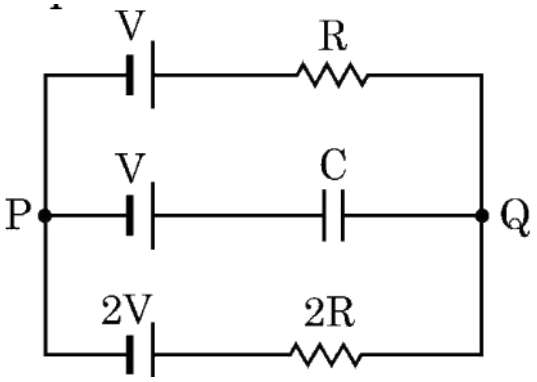
Q11. n identical cells, each of e.m.f. E and internal resistance r, are connected in series. Later on it was found out that two cells X and Y are connected in reverse polarities. Calculate the potential difference across the cell X.

[2025 • Set 55-1-3]

Q12. Two wires of the same material and the same radius have their lengths in the ratio 2 : 3. They are connected in parallel to a battery which supplies a current of 15 A. Find the current through the wires.

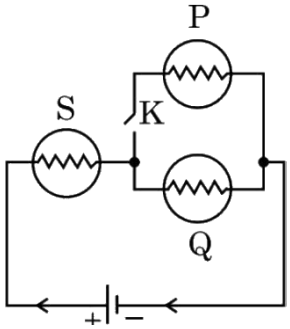
[2025 • Set 55-2-1]

Q13. In the circuit three ideal cells of e.m.f. V, V and 2V are connected to a resistor of resistance R, a capacitor of capacitance C and another resistor of resistance 2R as shown in figure. In the steady state find (i) the potential difference between P and Q and (ii) potential difference across capacitor C.



[2025 • Set 55-2-1]

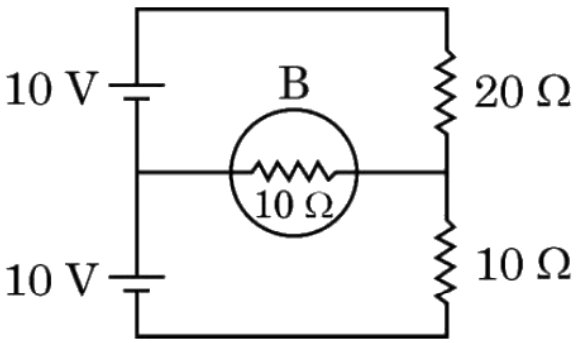
Q14. (a) In the given figure, three identical bulbs P, Q and S are connected to a battery.



(i) Compare the brightness of bulbs P and Q with that of bulb S when key K is closed.
(ii) Compare the brightness of the bulbs S and Q when the key K is opened. Justify your answer in both cases.

OR

(b) Two cells of emf $10\,\text{V}$ each, two resistors of $20\,\Omega$ and $10\,\Omega$ and a bulb B of $10\,\Omega$ resistance are connected together as shown in the figure. Find the current that flows through the bulb.



[2025 • Set 55-4-1]

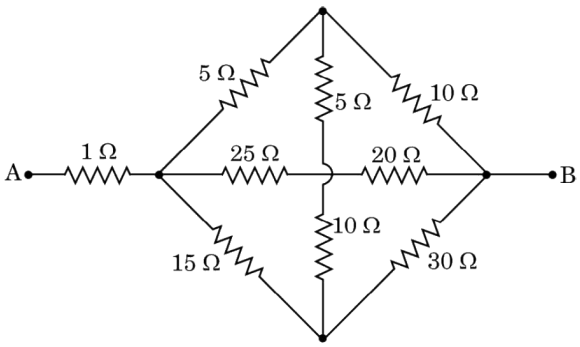
Q15. The resistance of a wire at $25°\text{C}$ is $10.0\,\Omega$. When heated to $125°\text{C}$, its resistance becomes $10.5\,\Omega$. Find (i) the temperature coefficient of resistance of the wire, and (ii) the resistance of the wire at $425°\text{C}$.

[2025 • Set 55-5-1]

Q16. A wire of resistance X ohm is gradually stretched till its length becomes twice its original length. If its new resistance becomes $40\ \Omega$, find the value of X.

[2025 • Set 55-5-2]

Q17. Find the equivalent resistance between points A and B for the network shown in the figure.



[2025 • Set 55-6-1]

Q18. A cell of emf E and internal resistance r is connected to an external variable resistance R. Plot a graph showing the variation of terminal voltage V of the cell as a function of current I, supplied by the cell. Explain how the emf of the cell and its internal resistance can be found from it.

[2025 • Set 55-6-2]

Q19. (a) What is the difference between 'velocity' and 'drift velocity' of electrons in a current-carrying conductor.

(b) A copper wire of uniform cross-sectional area carries a current of $3{\cdot}4\,\text{A}$. The drift velocity of conduction electrons is $0{\cdot}2\,\text{mm/s}$. If the number density of electrons in copper is $8{\cdot}5 \times 10^{28}\,\text{m}^{-3}$, find the area of cross-section of the wire.

[2025 • Set 55-6-3]

Q20. A cell of emf E and internal resistance r is connected across a resistor of variable resistance R. Show graphically the variation of

(a) the terminal voltage across the cell,

(b) the current supplied by the cell, with R as it is increased from 0 to the maximum value.

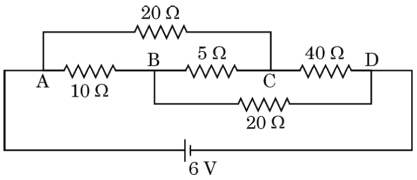
[2025 • Set 55-7-1]

Q21. Two wires made of the same material have the same length (l) but different cross-sectional areas A_1 and A_2. They are connected together with a cell of voltage V. Find the ratio of the drift velocities of free electrons in the two wires when they are joined in (i) series,

and (ii) parallel.

[2025 • Set 55-7-2]

Q22. Calculate the value of the current passing through the battery in the given circuit diagram.



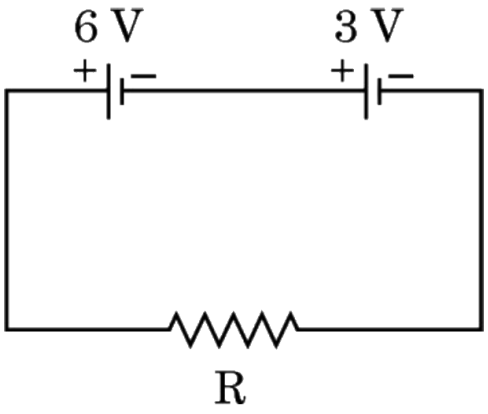
55/7/3 Page 10 of 31

[2025 • Set 55-7-3]

Q23. Find the temperature at which the resistance of a wire made of silver will be twice its resistance at $20°C$. Take $20°C$ as the reference temperature and temperature coefficient of resistance of silver at $20°C = 4.0 \times 10^{-3}\,K^{-1}$.

[2024 • Set 55-1-1]

Q24. Two batteries of emfs $6\,V$ and $3\,V$ and internal resistances $0.8\,\Omega$ and $0.2\,\Omega$ respectively are connected in series to an external resistance R, as shown in figure. Find the value of R so that the potential difference across the $6\,V$ battery be zero.



[2024 • Set 55-1-2]

Q25. A uniform wire of length L and area of cross-section A has resistance R. The wire is uniformly stretched so that its length increases by 25%. Calculate the percentage increase in the resistance of the wire.

[2024 • Set 55-1-3]

Q26. Define resistivity of a conductor. How does the resistivity of a conductor depend upon the following:

(a) Number density of free electrons in the conductor (n)

(b) Their relaxation time (τ)

[2024 • Set 55-2-1]

Q27. (a) "The electron drift speed is only a few mm/s for currents in the range of a few amperes for a given conductor." How then is current established almost the instant a circuit is closed? Explain.

(b) "$V = IR$ is a statement of Ohm's Law" is not true. Explain.

[2024 • Set 55-2-2]

Q28. An electric field $\vec{E}$ is maintained in a wire of length 'l' and area of cross-section 'a'. Derive the relation between the current density 'σ' in the wire and the electric field $\vec{E}$.

[2024 • Set 55-2-3]

Q29. What is meant by 'relaxation time' of free electrons in a conductor? Show that the resistance of a conductor can be expressed by $R = \dfrac{ml}{ne^2\tau A}$, where symbols have their usual meanings.

[2024 • Set 55-3-1]

Q30. Draw the circuit diagram of a Wheatstone bridge. Obtain the condition when no current flows through the galvanometer in it.

[2024 • Set 55-3-1]

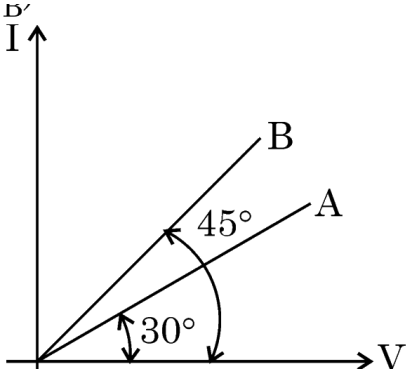
Q31. Two electric heaters have power ratings P_1 and P_2, at voltage V. They are connected in series to a dc source of voltage V. Find the power consumed by the combination. Will they consume the same power if connected in parallel across the same source?

[2024 • Set 55-4-1]

Q32. Two wires A and B of different metals have their lengths in ratio $1 : 2$ and their radii in ratio $2 : 1$ respectively. I-V graphs for them is shown in the figure. Find the ratio of their

(i) Resistances (R_A/R_B) and

(ii) Resistivities (ρ_A/ρ_B)

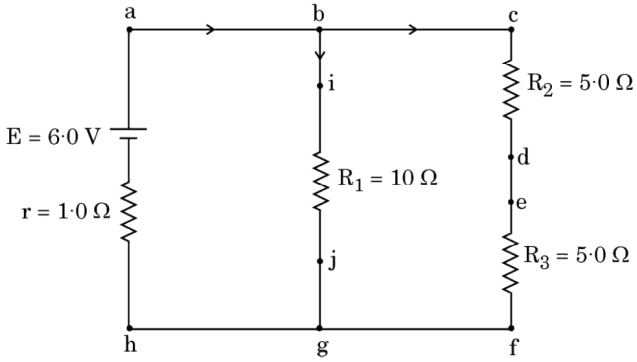


[2024 • Set 55-4-2]

Q33. Find the temperature at which the resistance of a conductor increases by 25% of its value at $27\,\text{C}$. The temperature coefficient of resistance of the conductor is $2.0 \times 10^{-4}\,\text{C}^{-1}$.

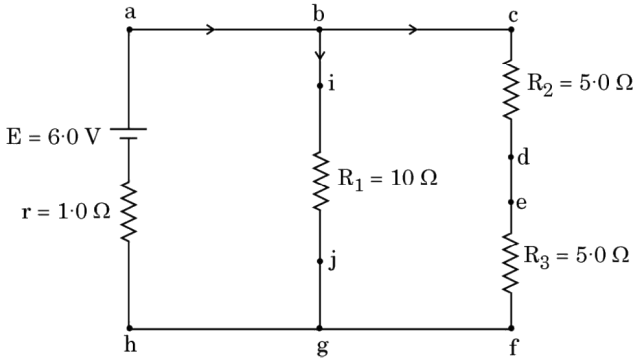
[2024 • Set 55-4-3]

Q34. Refer to the circuit diagram. Find the potential difference across resistance R_2.



[2023 • Set 55-1-1]

Q35. Refer to the circuit diagram. What is the power dissipated in resistance R_2?



[2023 • Set 55-1-1]

Q36. Write two differences between the emf and terminal potential difference of a cell. What is the most important precaution that one should take while drawing current from a cell?

[2023 • Set 55-4-1]

Q37. Two identical cells, each of emf E and internal resistance r, are connected with a load resistance R, first in series and then in parallel. Obtain the condition under which the current through R is same in both cases.

[2023 • Set 55-4-2]

Q38. A cell of emf E and internal resistance r is connected to a variable resistance R. Draw plots showing the variation of (a) terminal voltage V with R, and (b) V with current I, in the circuit.

[2023 • Set 55-4-3]

Q39. The potential difference applied across a given conductor is doubled. How will this affect

(i) the mobility of electrons and (ii) the current density in the conductor? Justify your answers.

[2023 • Set 55-5-1]

Q40. A potential difference (V) is applied across a conductor of length 'L' and cross-sectional area 'A'. How will the drift velocity of electrons and the current density be affected if another identical conductor of the same material were connected in series with the first conductor? Justify your answers.

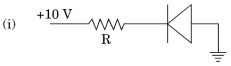
[2023 • Set 55-5-2]

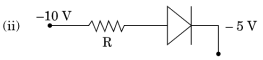
Q41. Two conductors, made of the same material have equal lengths but different cross-sectional areas A_1 and A_2 $(A_1 > A_2)$. They are connected in parallel across a cell. Show that the drift velocities of electrons in two conductors are equal.

[2023 • Set 55-5-3]

Q42. Define drift velocity of electrons in a conductor connected across a battery. Figure shows variation of the drift velocity (v_d) of electrons in two copper wires A and B of different lengths versus the potential difference (V) applied across their ends.

25. (a) State whether the given ideal diodes are forward or reverse biased :

(i) 

(ii) 

(b) The current in the forward bias is known to be more (~ mA) than the current in the reverse bias (~ μA). What is the reason then to operate the photodiodes in reverse bias ? 2

SECTION D

26. (a) Two concentric circular coils X and Y of radii r_1 and r_2 $(r_1 > r_2)$ having N_1 and N_2 turns respectively are placed coaxially with centres coinciding. Obtain an expression for (i) the mutual inductance for the arrangement, and (ii) the magnetic flux linked with coil Y when current I flows through coil X. 3

OR

(b) What are eddy currents ? Why does the pendulum plate with holes or slots reduce electromagnetic damping ? How are the eddy currents minimised in the

(i) What does the slope of the line represent?

(ii) Which one of the two wires is longer?

[2021]

Q43. Explain the principle of working of a meter bridge. Draw the circuit diagram for determination of an unknown resistance using it.

[2020 • Set 55-1-1]

Q44. Define the term 'mobility' of charge carriers in a current carrying conductor. Obtain the relation for mobility in terms of relaxation time.

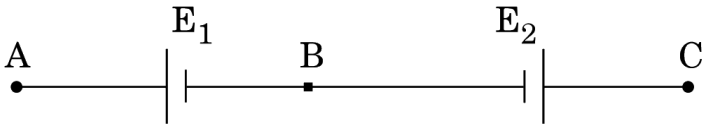
OR

Define the term 'drift velocity' of electrons in a current carrying conductor. Obtain the

relationship between the current density and the drift velocity of electrons.

[2020 • Set 55-2-1]

Q45. Two cells of emf E_1 and E_2 $(E_1 > E_2)$ are connected as shown in the figure below. When a potentiometer is used to measure potential difference between the points A and B, the balancing length of the potentiometer wire is 300 cm. But the same potentiometer for the potential difference between points A and C, gives the balancing length 100 cm. Find $\frac{E_1}{E_2}$.



[2020 • Set 55-3-1]

Q46. A battery of emf 12 V and internal resistance $4\,\Omega$ is connected to an external resistance R. If the current in the resistance is 0.5 A, calculate the value of (a) R, and (b) the terminal voltage of the battery.

[2020 • Set 55-3-2]

Q47. The number densities of free electrons in three conductors X, Y and Z are in the ratio $4 : 1 : 8$, and their electrical conductivities are in the ratio $2 : 1 : 2$. For which conductor will the relaxation time of free electrons be (a) maximum, and (b) minimum?

[2020 • Set 55-3-3]

Q48. A wire of length L_1 has a resistance R_1. It is gradually stretched till its length becomes $2L_1$.

(a) Plot a graph showing variation of its resistance R with its length l during stretching.

(b) What will be its resistance when its length becomes $2L_1$?

[2020 • Set 55-4-1]

Q49. A uniform wire is cut into three parts with their lengths in the ratio $2 : 3 : 6$. The ends of each of these three parts are connected across an ideal battery of 10 V. If a current of 5 A is drawn from the battery, find the initial resistance of the wire.

[2020 • Set 55-4-2]

Q50. 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.

[2019 • Set 55-1-1]

Q51. A set of 'n' identical resistors, each of resistance 'R' when connected in series have an effective resistance 'X'. When they are connected in parallel, their effective resistance

becomes 'Y'. Find out the product of X and Y.

[2019 • Set 55-5-1]

Q52. A wire of resistance R, length l and area of cross-section A, is cut into two parts, having their lengths in the ratio $1 : 2$. The shorter wire is now stretched till its length becomes equal to that of the longer wire. If they are now connected in parallel, find the net resistance of the combination.

[2019 • Set 55-5-2]

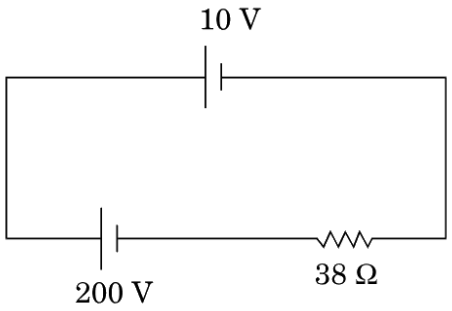
Q53. A wire of resistance R, length l and uniform area of cross-section A is stretched till its length becomes double. It is then cut into three pieces of equal length which are connected in parallel. Find the net resistance of the combination in terms of the resistance R.

[2019 • Set 55-5-3]

Q54. Two electric bulbs P and Q have their resistances in the ratio of $1 : 2$. They are connected in series across a battery. Find the ratio of the power dissipation in these bulbs.

[2018]

Q55. A 10 V cell of negligible internal resistance is connected in parallel across a battery of emf 200 V and internal resistance $38\ \Omega$ as shown in the figure. Find the value of current in the circuit.

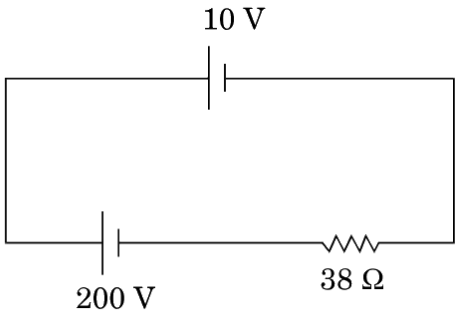


[2018]

Q56. 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 $9\ \Omega$ is used in the external circuit of the cell, the balance point shifts to 300 cm. Determine the internal resistance of the cell.

[2018]

Q57. 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 figure. Find the value of current in the circuit.



OR

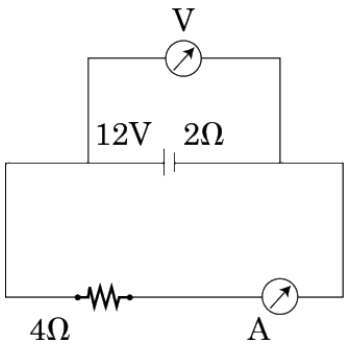
In a potentiometer arrangement for determining the emf of a cell, the balance point of the cell in open circuit is 350 cm. When a resistance of 9 Ω is used in the external circuit of the cell, the balance point shifts to 300 cm. Determine the internal resistance of the cell.

[2018]

Q58. A battery of emf 12 V and internal resistance 2 Ω is connected to a 4 Ω resistor as shown in the figure.

(a) Show that a voltmeter when placed across the cell and across the resistor, in turn, gives the same reading.

(b) To record the voltage and the current in the circuit, why is voltmeter placed in parallel and ammeter in series in the circuit?



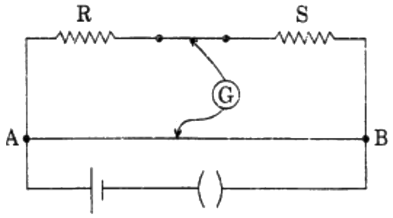
[2016]

Q59. When 5 V potential difference is applied across a wire of length 0.1 m, the drift speed of electrons is 2.5×10^{-4} m/s. If the electron density in the wire is 8×10^{28} m^{-3}, calculate the resistivity of the material of wire.

[2016]

Q60. In a meter bridge shown in the figure, the balance point is found to be 40 cm from end A. If a resistance of 10 Ω is connected in series with R, balance point is obtained 60 cm from

A. Calculate the values of R and S.



[2015]

Q61. Use Kirchhoff's rules to obtain conditions for the balance condition in a Wheatstone bridge.

[2015]

Q62. State Kirchhoff's rules. Explain briefly how these rules are justified.

[2014]

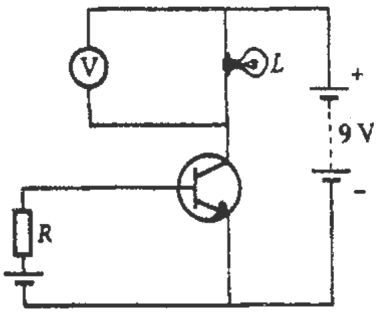
Q63. Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area 2.5×10^{-7} m^2 carrying a current of 2.7 A. Assume the density of conduction electrons to be 9×10^{28} m^{-3}.

[2014]

Q64. A cell of emf 'E' 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.

[2014]

Q65. In the given circuit diagram, a voltmeter 'V' is connected across a lamp 'L'. How would (i) the brightness of the lamp and (ii) voltmeter reading 'V' be affected, if the value of resistance 'R' is decreased? Justify your answer.



[2013]

Q66. Two primary cells of e.m.f. E_1 and E_2 ($E_1 > E_2$) are connected to the potentiometer wire AB as shown in the figure. If the balancing lengths for the two combinations of the cells are 250 cm and 400 cm, find the ratio of E_1 and E_2.

[2013]

Q67. A cell of emf E 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

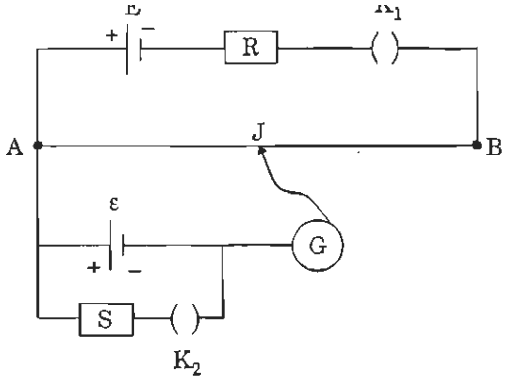
(iv) with R_1 and R_2 in parallel combination The currents measured in the four cases are $0.42\,\text{A}$, $1.05\,\text{A}$, $1.4\,\text{A}$ and $4.2\,\text{A}$, but not necessarily in that order. Identify the currents corresponding to the four cases mentioned above.

[2012]

Q68. Two students X and Y perform an experiment on potentiometer separately using the circuit given below. Keeping other parameters unchanged, how will the position of the null point be affected if

(i) 'X' increases the value of resistance R in the set-up by keeping the key K_1 closed and the key K_2 open?

(ii) 'Y' decreases the value of resistance S in the set-up, while the key K_2 remains open and the key K_1 closed? Justify.

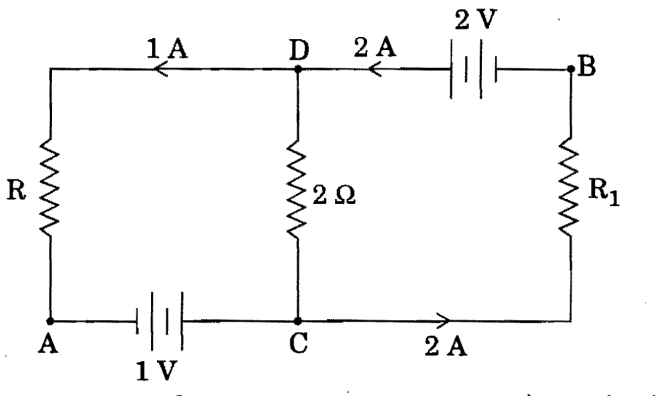


[2012]

Q69. A conductor of length 'l' is connected to a dc source of potential 'V'. If the length of the conductor is tripled by gradually stretching it, keeping 'V' constant, how will (i) drift speed of electrons and (ii) resistance of the conductor be affected? Justify your answer.

[2012]

Q70. In the given circuit, assuming point A to be at zero potential, use Kirchhoff's rules to determine the potential at point B.

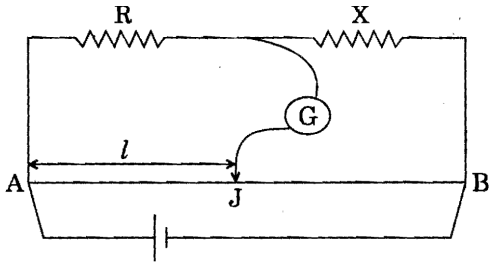


[2011]

Q71. In the metre bridge experiment, balance point was observed at J with $AJ = l$.

(i) The values of R and X were doubled and then interchanged. What would be the new position of balance point?

(ii) If the galvanometer and battery are interchanged at the balance position, how will the balance point get affected?



[2011]

Q72. (a) You are required to select a carbon resistor of resistance $47\,\text{k}\Omega \pm 10\%$ from a large collection. What should be the sequence of colour bands used to code it?

(b) Write two characteristics of manganin which make it suitable for making standard resistances.

[2011 • Set 55-2-1]

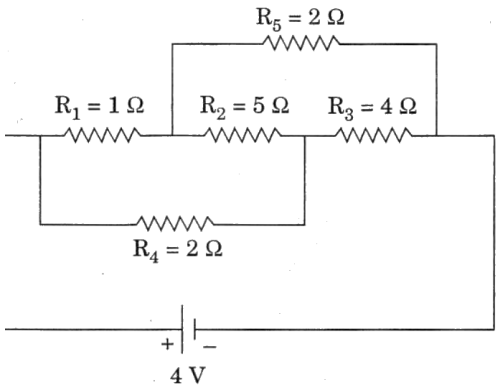
Q73. Derive an expression for drift velocity of free electrons in a conductor in terms of relaxation time.

[2009]

Q74. A cell of emf E and internal resistance r is connected across a variable resistor R. Plot a graph showing the variation of terminal potential V with resistance R. Predict from the graph the condition under which V becomes equal to E.

[2009]

Q75. Calculate the current drawn from the battery in the given network.



[2009]

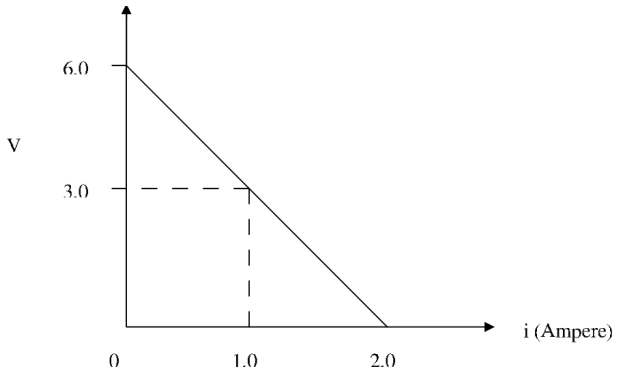
Q76. A wire of $15\ \Omega$ resistance is gradually stretched to double its original length. It is then cut into two equal parts. These parts are then connected in parallel across a $3.0\ V$ battery. Find the current drawn from the battery.

[2009]

Q77. 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.

[2008]

Q78. The following 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?

[2008]

Q79. A cylindrical metallic wire is stretched to increase its length by 5%. Calculate the

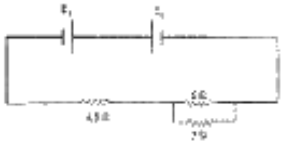
percentage change in its resistance.

[2007]

Q80. 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 mA, through the resistor.

[2007]

Q81. Two cells E_1 and E_2 in the given circuit diagram have an emf of 5 V and 9 V and internal resistance of $0.3\ \Omega$ and $1.2\ \Omega$ respectively. Calculate the value of current flowing through the resistance of $3\ \Omega$.



[2006]

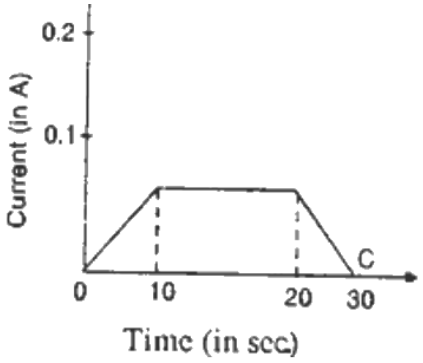
Q82. Write the mathematical relation between mobility and drift velocity of charge carriers in a conductor. Name the mobile charge carriers responsible for conduction of electric current in (i) an electrolyte (ii) an ionised gas.

[2006]

Q83. Draw V-I graph for ohmic and non-ohmic materials. Give one example for each.

[2005]

Q84. In a copper voltameter, a varying electric current, as shown in graph, is passed. The mass of copper deposited at the end of 30 seconds is m grams. Using the graph, find the value of e.c.e. (electrochemical equivalent) of copper in g/C.

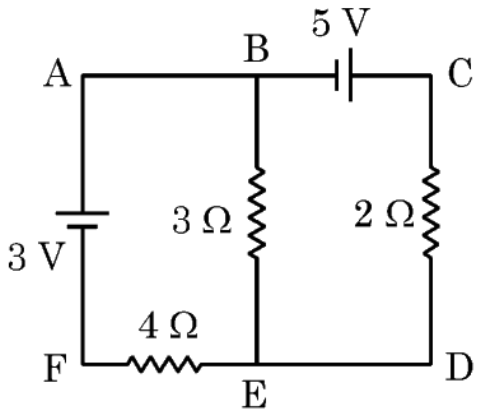


[2003]

3-Mark Questions (95 questions · Section C · SA)

Q1. (a) Explain the statement: "Current is a scalar although we represent current with an arrow".

(b) Use Kirchhoff's rules to find the current through $3\ \Omega$ resistor in the circuit shown in the figure:



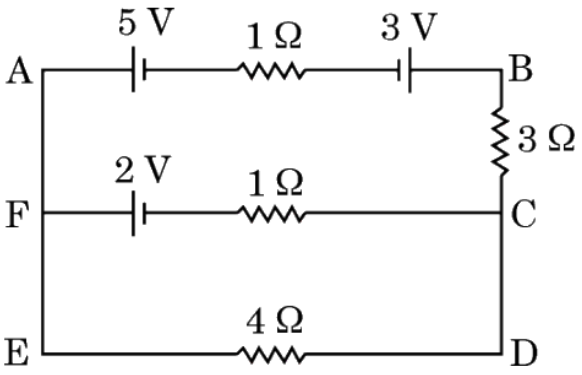
[2026 • Set 55-2-1]

Q2. (a) Establish the relation between drift velocity of electrons (v_d) and electric current (I) in a conductor.

(b) How is v_d affected when the length of the conductor is doubled, keeping the voltage applied across the conductor constant?

[2026 • Set 55-3-1]

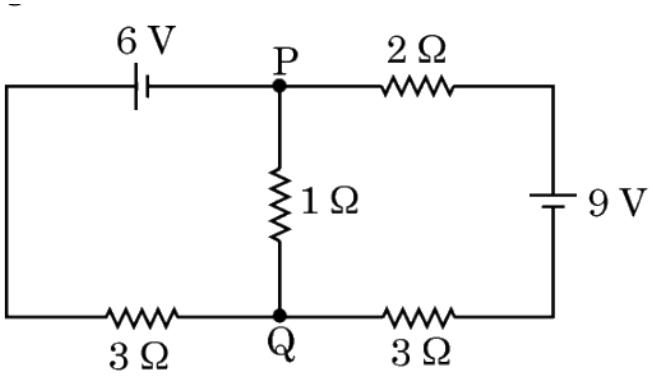
Q3. State Kirchhoff's rules. Using these rules, find the current flowing through branch FC in the given circuit.



[2026 • Set 55-4-1]

Q4. (a) The two Kirchhoff's rules are based on law of conservation of two physical quantities. Name the quantities.

(b) Find magnitude and direction of current in 1 Ω resistor in the given circuit.



[2026 • Set 55-4-2]

Q5. (a) 'Current is a scalar quantity, although we represent current with an arrow.' Explain.

(b) Derive the balance condition of a Wheatstone Bridge.

[2026 • Set 55-4-3]

Q6. (a) Two batteries of emfs $3\,\text{V}$ & $6\,\text{V}$ and internal resistances $0.2\,\Omega$ & $0.4\,\Omega$ are connected in parallel. This combination is connected to a $4\,\Omega$ resistor. Find: (i) the equivalent emf of the combination (ii) the equivalent internal resistance of the combination (iii) the current drawn from the combination

OR

(b) (i) A conductor of length l is connected across an ideal cell of emf E. Keeping the cell connected, the length of the conductor is increased to $2l$ by gradually stretching it. If R and R' are initial and final values of resistance and v_d and v'_d are initial and final values of drift velocity, find the relation between (i) R' and R and (ii) v'_d and v_d. (ii) When electrons drift in a conductor from lower to higher potential, does it mean that all the 'free electrons' of the conductor are moving in the same direction?

[2025 • Set 55-1-1]

Q7. (a) A cell of e.m.f. E and internal resistance r is connected with a variable external resistance R and a voltmeter showing potential drop V across R. Obtain the relationship between V, E, R and r.

(b) Draw the shape of the graph showing the variation of terminal voltage V of the cell as a function of current I drawn from it. How one can determine the e.m.f. of the cell and its internal resistance from this graph?

[2025 • Set 55-2-1]

Q8. (a) Define resistivity of a conductor. Discuss its dependence on temperature of the conductor and draw a plot of resistivity of copper as a function of temperature.

(b) (i) "A low voltage battery from which high current is required must have low internal resistance." Justify. (ii) "A high voltage battery must have a large internal resistance." Justify.

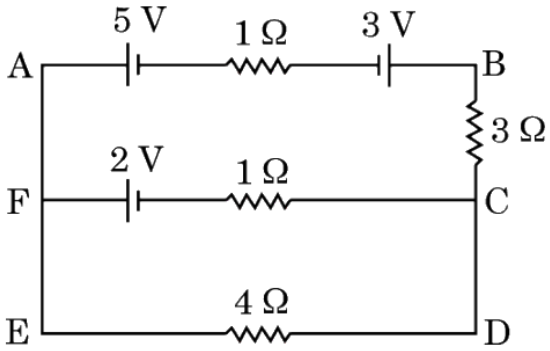
[2025 • Set 55-2-2]

Q9. (a) Define Electrical conductivity. Obtain the expression of electrical conductivity of a conductor in terms of number density and relaxation time of free electrons.

(b) Explain qualitative change in resistivity of a conductor with temperature using expression obtained in (a).

[2025 • Set 55-2-3]

Q10. (a) (i) Derive an expression for the resistivity of a conductor in terms of number density of free electrons and relaxation time. (ii) The figure shows the plot of current through a cross-section of wire over two different time intervals. Compare the charges (Q_1 and Q_2) that pass through the cross-section during these time intervals.



OR

(b) (i) A battery of emf E and internal resistance r is connected to a variable external resistance R. (I) Obtain the expression for current I in the circuit and the value of maximum current the battery can supply. (II) Obtain the terminal voltage V across the battery and its maximum possible value. (ii) The above battery sends a current I_1 when $R = R_1$ and a current I_2 when $R = R_2$. Obtain the internal resistance of the battery in terms of I_1, I_2, R_1 and R_2.

[2025 • Set 55-4-1]

Q11. What is the difference between 'emf' and 'terminal voltage' of a cell? Two cells of emfs E_1 and E_2 and internal resistances r_1 and r_2 are connected in parallel. Derive an expression for the emf and internal resistance of the equivalent cell.

[2025 • Set 55-6-1]

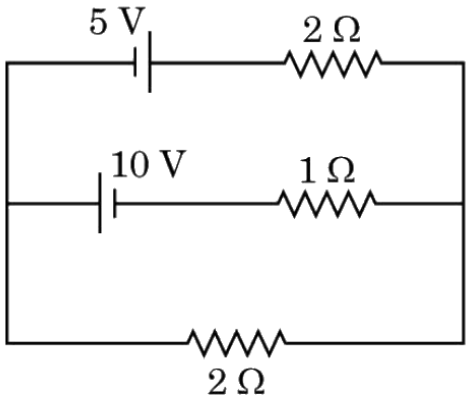
Q12. (a) Define the term 'drift velocity' of conduction electrons in a conductor.

(b) A conductor of length l and area of cross-section A is connected across an ideal battery

of emf V. Derive the formula for the current density in terms of relaxation time τ.

[2025 • Set 55-6-2]

Q13. State Kirchhoff's laws. Apply these laws to find the values of current flowing in the three branches of the given circuit.



[2025 • Set 55-6-3]

Q14. Three cells A, B and C of emfs 2 V, 3 V and 5 V respectively are connected in parallel to each other. Their internal resistances are $5\ \Omega$, $5\ \Omega$ and $1\ \Omega$ respectively. Calculate the currents flowing through the cells A, B and C.

[2025 • Set 55-7-1]

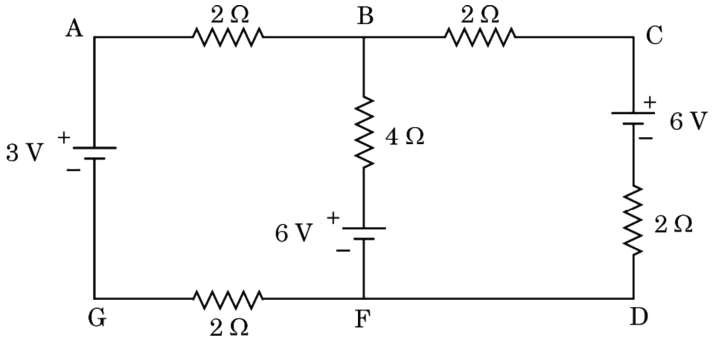
Q15. Define 'current density'. Is it a scalar or a vector? An electric field $\vec{E}$ is maintained in a metallic conductor. If n be the number of electrons (mass m, charge $-e$) per unit volume in the conductor and τ its relaxation time, show that the current density $\vec{j} = \sigma\vec{E}$, where $\sigma = \dfrac{ne^2\tau}{m}$.

[2024 • Set 55-1-1]

Q16. What is a Wheatstone bridge? Obtain the necessary conditions under which the Wheatstone bridge is balanced.

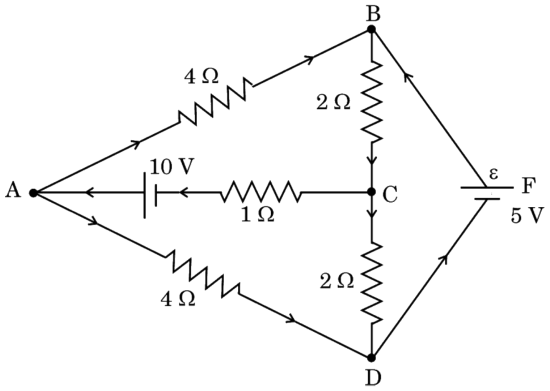
[2024 • Set 55-1-1]

Q17. The figure shows a circuit with three ideal batteries. Find the magnitude and direction of currents in the branches AG, BF and CD.



[2024 • Set 55-2-1]

Q18. Determine the current in branches AB, AC and BC of the network shown in figure.



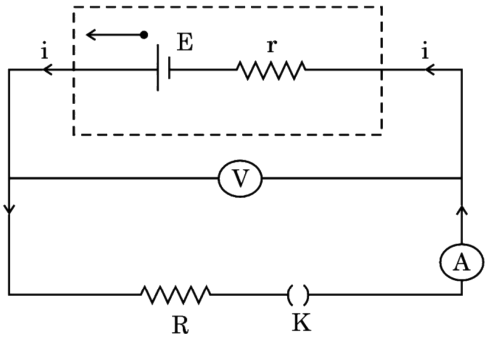
[2024 • Set 55-3-1]

Q19. A battery of unknown emf E and internal resistance r is connected in a circuit as shown in the figure. When the key (K) is open, the voltmeter reads 10.0 V and ammeter reads 0 A. In the closed circuit, the voltmeter reads 6.0 V and ammeter reads 2.0 A. Calculate:

(a) emf of the battery,

(b) internal resistance of the battery (r), and

(c) external resistance (R).



[2024 • Set 55-3-2]

Q20. A current of 1.6 A flows through a wire when a potential difference of 1.0 V is applied across it. The length and cross-sectional area of the wire are 1.0 m and 1.0×10^{-7} m^2 respectively. Calculate:

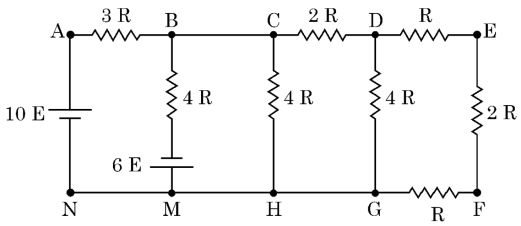
(a) Electric field across the wire

(b) Current density

(c) Average relaxation time (τ) (Number density of free electrons in the wire is 9.0×10^{28} m^{-3})

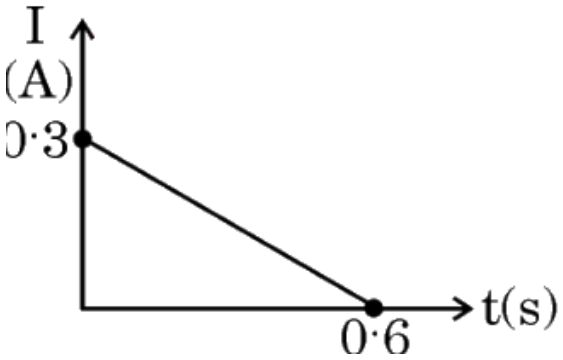
[2024 • Set 55-3-3]

Q21. Find the current in branch BM in the network shown:



[2024 • Set 55-4-1]

Q22. Find the currents flowing through the branches AB and BC in the network shown.

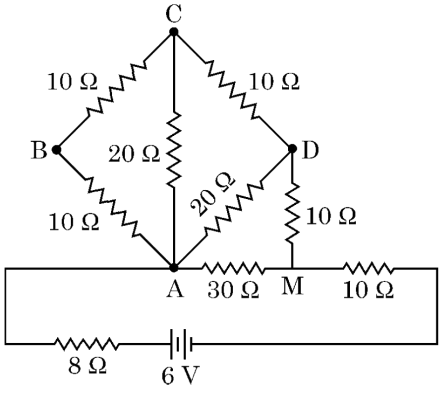


[2024 • Set 55-4-2]

Q23. In the given network, calculate:

(i) effective resistance between points A and M, and

(ii) power supplied by the battery.



[2024 • Set 55-4-3]

Q24. **(i)** Define 'temperature coefficient of resistance' of a metal.

(ii) Show the variation of resistivity of copper with rise in temperature.

(iii) The resistance of a wire is $10\,\Omega$ at $27°C$. Find its resistance at $-73°C$. The temperature

coefficient of resistance of the material of the wire is $1.70 \times 10^{-4}\,°C^{-1}$.

[2024 • Set 55-5-2]

Q25. A potential difference of $1.0\,V$ is applied across a conductor of length $5.0\,m$ and area of cross-section $1.0\,mm^2$. When current of $4.25\,A$ is passed through the conductor, calculate (i) the drift speed and (ii) relaxation time, of electrons. (Given number density of electrons in the conductor, $n = 8.5 \times 10^{28}\,m^{-3}$).

[2024 • Set 55-5-3]

Q26. Define current density and relaxation time. Derive an expression for resistivity of a conductor in terms of number density of charge carriers in the conductor and relaxation time.

[2023 • Set 55-2-1]

Q27. Two cells of emf E_1 and E_2 and internal resistances r_1 and r_2 are connected in parallel, with their terminals of the same polarity connected together. Obtain an expression for the equivalent emf of the combination.

[2023 • Set 55-2-2]

Q28. A potential difference V is applied across a conductor of length l and cross-sectional area A. Briefly explain how the current density j in the conductor will be affected if

(a) the potential difference V is doubled,

(b) the conductor were gradually stretched to reduce its cross-sectional area to $\frac{A}{4}$ and then the same potential difference V is applied across it.

[2023 • Set 55-2-3]

Q29. A potential difference V is applied across a conductor of length l and uniform cross-section area A. How will the (i) electric field E, (ii) drift velocity v_d, and (iii) current density j be affected when (a) V is doubled and (b) l is halved (keeping other factors constant)?

[2023 • Set 55-3-1]

Q30. A potential difference 'V' is applied across a load resistor of resistance R. V and R can be varied. If the current that flows in the circuit is I, draw a plot showing the variation of power consumed by the resistor as a function of:

(a) R, keeping V constant

(b) I, keeping R constant

(c) V, keeping R constant

[2023 • Set 55-3-2]

Q31. Obtain a relation between the current flowing in a conductor and drift velocity of electrons in it. Hence, obtain Ohm's law.

[2023 • Set 55-3-3]

Q32. Two cells of emf E_1 and E_2 have their internal resistances r_1 and r_2, respectively. Deduce an expression for the equivalent emf and internal resistance of their parallel combination when connected across an external resistance R. Assume that the two cells are supporting each other.

[2020 • Set 55-1-1]

Q33. In case the two cells are identical, each of emf $E = 5\,\text{V}$ and internal resistance $r = 2\,\Omega$, calculate the voltage across the external resistance $R = 10\,\Omega$.

[2020 • Set 55-1-1]

Q34. (a) Derive the condition of balance for Wheatstone bridge.

(b) Draw the circuit diagram of a meter bridge to explain how it is based on Wheatstone bridge.

[2020 • Set 55-2-1]

Q35. (a) Differentiate between the random velocity and the drift velocity of electrons in an electrical conductor. Give their order of magnitudes.

(b) A conductor of uniform cross-sectional area is connected across a dc source of variable voltage. Draw a graph showing variation of drift velocity of electrons (v_d) as a function of current density (J) in it.

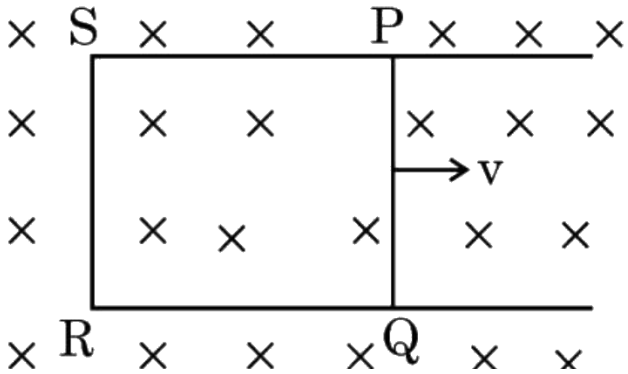
[2020 • Set 55-3-1]

Q36. (a) Write the relationship between mobility and drift velocity in a current carrying conductor.

(b) Two aluminium wires have their lengths in the ratio $2 : 3$ and radii in the ratio $1 : 3$. These are connected in parallel across a battery of emf E and of negligible internal resistance. Find the ratio of drift velocities of the electrons in the two wires.

[2020 • Set 55-3-2]

Q37. Using Kirchhoff's rules, calculate the current (I_g) that flows through the galvanometer of resistance $15\,\Omega$ in the circuit diagram shown in the figure.



[2020 • Set 55-3-3]

Q38. (a) Explain the principle of working of a potentiometer.

(b) In a potentiometer, a standard source of emf 5 V and negligible internal resistance maintains a steady current through the potentiometer wire of length 10 m. Two primary cells of emf E_1 and E_2 are joined together in a series with (i) same polarity and (ii) opposite polarity. The combination is connected to the potentiometer circuit in each case. The balancing length of the wire in the two cases are found to be 700 cm and 100 cm, respectively. Find the values of emf of the two cells.

[2020 • Set 55-4-1]

Q39. (a) Differentiate between electrical resistance and resistivity of a conductor.

(b) Two metallic rods, each of length L, area of cross A_1 and A_2, having resistivities ρ_1 and ρ_2 are connected in parallel across a d.c. battery. Obtain the expression for the effective resistivity of this combination.

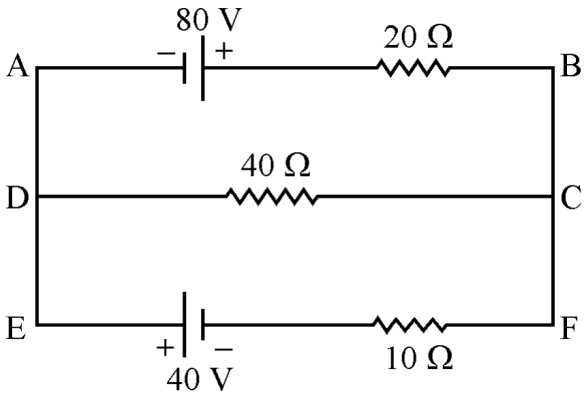
[2020 • Set 55-5-1]

Q40. (a) Define internal resistance of a cell.

(b) A cell of emf E and internal resistance r is connected across a variable resistor R. Plot the shape of graphs showing variation of terminal voltage V with (i) R and (ii) circuit current I.

[2020 • Set 55-5-2]

Q41. Using Kirchhoff's rules, calculate the current through the $40\,\Omega$ and $20\,\Omega$ resistors in the following circuit:



[2019 • Set 55-1-1]

Q42. What is end error in a metre bridge? How is it overcome? The resistances in the two arms of the metre bridge are $R = 5\,\Omega$ and S respectively. When the resistance S is shunted with an equal resistance, the new balance length is found to be $1.5\,l_1$, where l_1 is the initial balancing length. Calculate the value of S.

[2019 • Set 55-1-1]

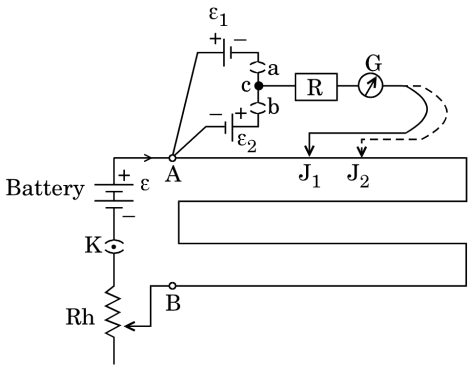
Q43. Show, on a plot, variation of resistivity of (i) a conductor, and (ii) a typical semiconductor as a function of temperature. Using the expression for the resistivity in terms of number density and relaxation time between the collisions, explain how resistivity in the case of a conductor increases while it decreases in a semiconductor, with the rise of temperature.

[2019 • Set 55-2-1]

Q44. Twelve wires each having a resistance of $3\,\Omega$ are connected to form a cubical network. A battery of $10\,\text{V}$ and negligible internal resistance is connected across the diagonally opposite corners of this network. Determine its equivalent resistance and the current along each edge of the cube.

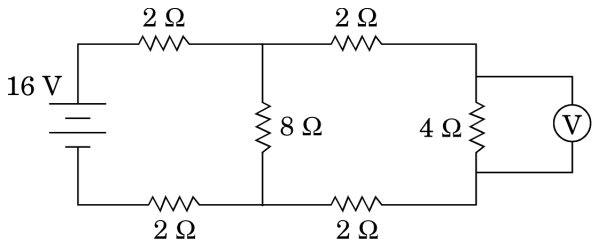
[2019 • Set 55-3-1]

Q45. A student uses the circuit diagram of a potentiometer as shown in the figure. (a) For a steady current I passing through the potentiometer wire, he gets a null point for the cell ε_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?



[2019 • Set 55-3-1]

Q46. In the circuit given below, find the voltmeter reading across a $4\,\Omega$ resistor.



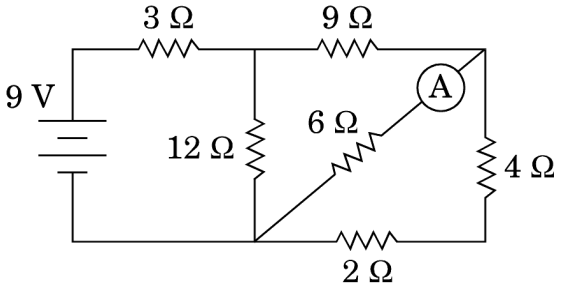
[2019 • Set 55-3-2]

Q47. (a) Use Kirchhoff's rules to obtain the balance condition in Wheatstone bridge.

(b) Give one practical application that is based on this principle.

[2019 • Set 55-3-2]

Q48. In the circuit shown in the figure, find the value of the current shown in the ammeter A.



[2019 • Set 55-3-3]

Q49. (a) Obtain the expression for the current flowing through a conductor having number density of the electrons n, area of cross-section A in terms of the drift velocity v_d.

(b) How does the resistivity of a semiconductor change with rise of temperature? Explain.

[2019 • Set 55-3-3]

Q50. (a) Draw a graph showing the variation of current versus voltage in an electrolyte when an external resistance is also connected.

(b) (i) The graph between resistance (R) and temperature (T) for Hg is shown in figure (a). Explain the behaviour of Hg near $4\,K$. (ii) In which region of the graph shown in figure (b) is the resistance negative and why?

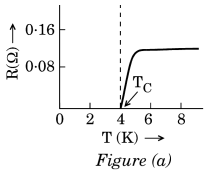


Figure (a)

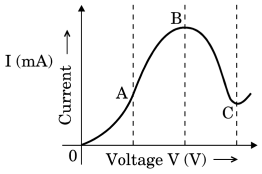
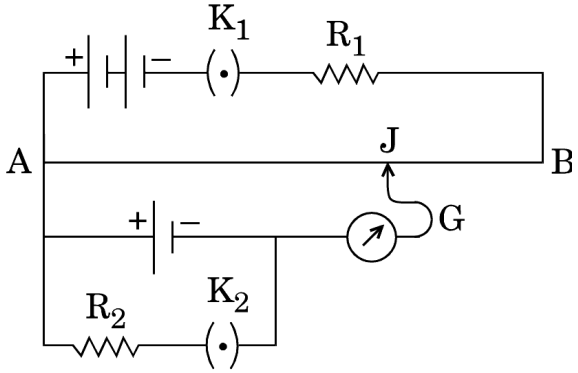


Figure (b)

[2019 • Set 55-4-1]

Q51. (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.



OR

State the underlying principle of meter bridge. Draw the circuit diagram and explain how the unknown resistance of a conductor can be determined by this method.

[2019 • Set 55-4-1]

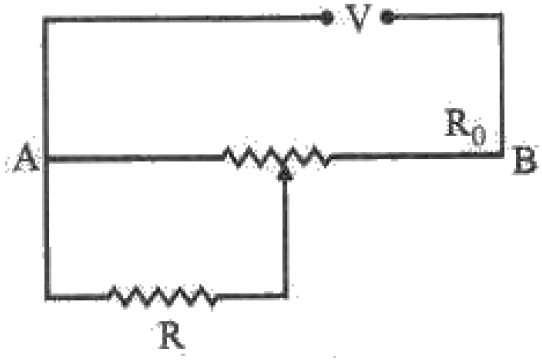
Q52. (a) Define the term 'conductivity' of a metallic wire. Write its SI unit.

(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 $\vec{E}$.

[2018]

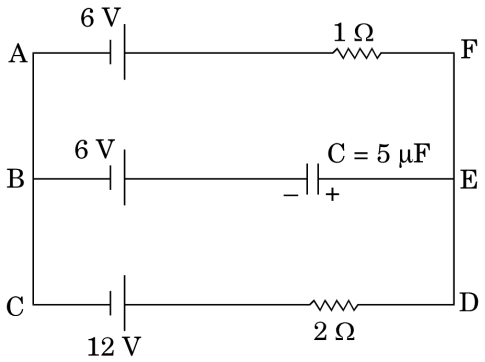
Q53. A resistance of R draws current from a potentiometer. The potentiometer wire, AB, has a total resistance of R_0. A voltage V is supplied to the potentiometer. Derive an expression

for the voltage across R when the sliding contact is in the middle of potentiometer wire.



[2017]

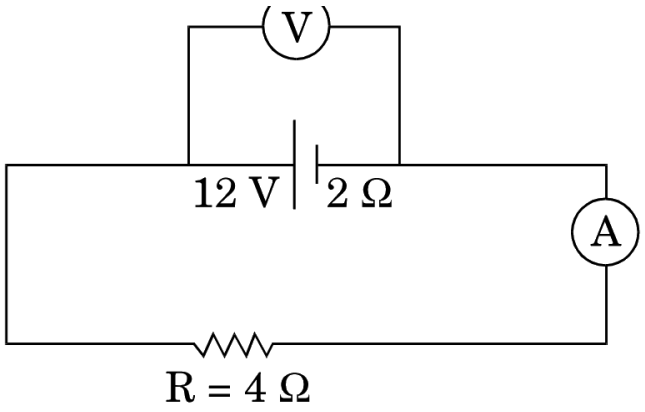
Q54. In the given circuit, with steady current, calculate the potential difference across the capacitor and the charge stored in it.



[2017]

Q55. (a) The potential difference applied across a given resistor is altered so that the heat produced per second increases by a factor of 9. By what factor does the applied potential difference change?

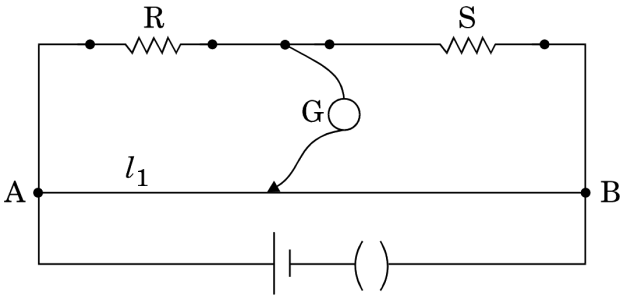
(b) In the figure shown, an ammeter A and a resistor of $4\ \Omega$ are connected to the terminals of the source. The emf of the source is 12 V having an internal resistance of $2\ \Omega$. Calculate the voltmeter and ammeter readings.



[2017]

Q56. (a) Write the principle of working of a metre bridge.

(b) In a metre bridge, the balance point is found at a distance l_1 with resistances R and S as shown in the figure.



An unknown resistance X is now connected in parallel to the resistance S and the balance point is found at a distance l_2. Obtain a formula for X in terms of l_1, l_2 and S.

[2017]

Q57. (i) Derive an expression for drift velocity of free electrons.

(ii) How does drift velocity of electrons in a metallic conductor vary with increase in temperature? Explain.

[2016]

Q58. Two identical cells of emf 1.5 V each joined in parallel supply energy to an external circuit consisting of two resistances of $7\ \Omega$ each joined in parallel. A very high resistance voltmeter reads the terminal voltage of cells to be 1.4 V. Calculate the internal resistance of each cell.

[2016]

Q59. State the underlying principle of a potentiometer. Write two factors by which current sensitivity of a potentiometer can be increased. Why is a potentiometer preferred over a voltmeter for measuring the emf of a cell?

[2015]

Q60. A cell of emf 'E' 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 $R = 4\,\Omega$, the current is 1 A and when R is increased to $9\,\Omega$, the current reduces to 0.5 A. Find the values of the emf E and internal resistance r.

[2015]

Q61. A potentiometer wire of length 1 m has a resistance of $10\,\Omega$. It is connected to a 6 V battery in series with a resistance of $5\,\Omega$. Determine the emf of the primary cell which

gives a balance point at 40 cm.

[2014]

Q62. Answer the following :

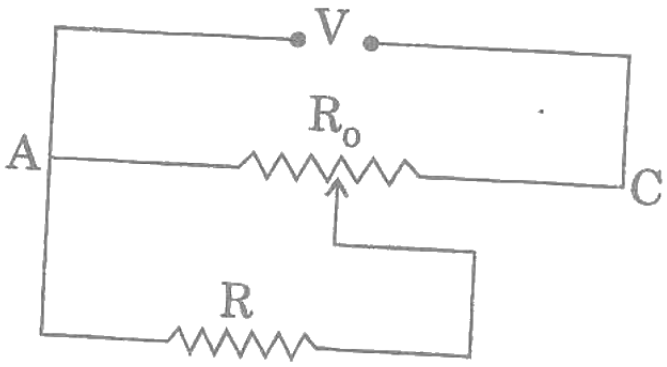
(a) Why are the connections between the resistors in a meter bridge made of thick copper strips ?

(b) Why is it generally preferred to obtain the balance point in the middle of the meter bridge wire ?

(c) Which material is used for the meter bridge wire and why ?

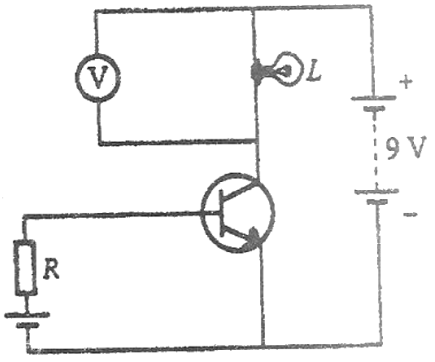
OR

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



[2014]

Q63. 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 $12.5\,\Omega$. Determine the resistance of X. Why are the connections between resistors in a metre bridge made of thick copper strips? What happens if the galvanometer and cell are interchanged at the balance point of the bridge? Would the galvanometer show any current?



[2013]

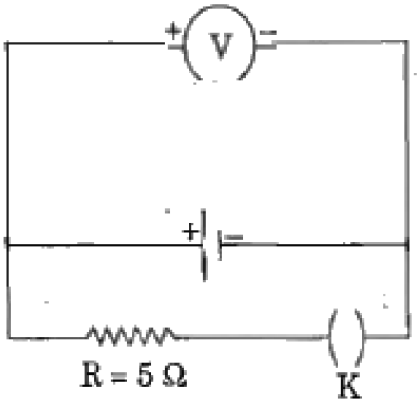
Q64. Define the term 'resistivity' and 'conductivity' and state their S.I. unit. Draw a graph showing the variation of resistivity with temperature for a typical semiconductor.

[2013]

Q65. State the principle of potentiometer. With the help of circuit diagram, describe a method to find the internal resistance of a primary cell.

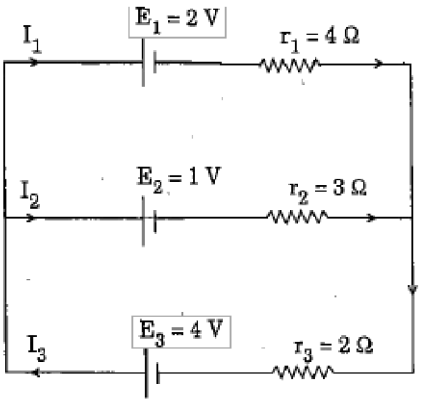
[2013]

Q66. Write any two factors on which internal resistance of a cell depends. The reading on a high resistance voltmeter, when a cell is connected across it, is $2.2\,\text{V}$. When the terminals of the cell are also connected to a resistance of $5\,\Omega$ as shown in the circuit, the voltmeter reading drops to $1.8\,\text{V}$. Find the internal resistance of the cell.



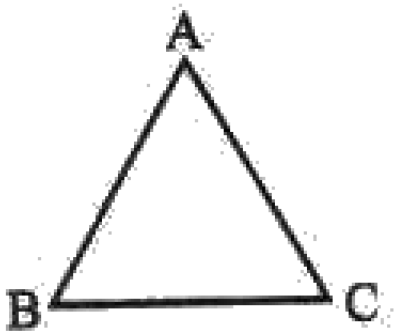
[2012]

Q67. 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.



[2012]

Q68. Calculate the value of the resistance R in the circuit shown in the figure so that the current in the circuit is $0.2\,\text{A}$. What would be the potential difference between points B and E?

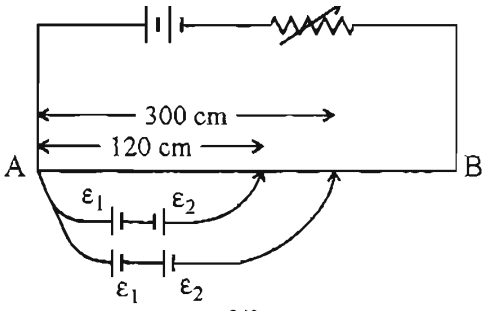


[2012]

Q69. 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.

[2012]

Q70. In the figure a long uniform potentiometer wire AB is having a constant potential gradient along its length. The null points for the two primary cells of emfs ε_1 and ε_2 connected in the manner shown are obtained at a distance of $120\,\text{cm}$ and $300\,\text{cm}$ 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?



[2012]

Q71. Using Kirchhoff's rules determine the value of unknown resistance R in the circuit so that no current flows through $4\,\Omega$ resistance. Also find the potential difference between A and D.

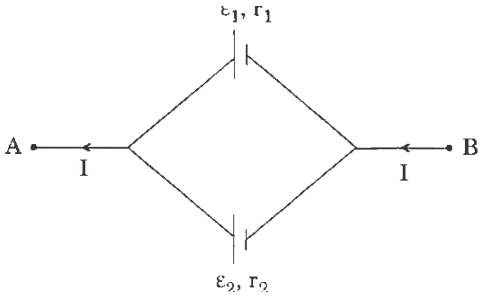
[2012]

Q72. Two cells of emfs ε_1, ε_2 and internal resistance r_1 and r_2 respectively are connected in parallel as shown in the figure. Deduce the expressions for

(i) the equivalent e.m.f. of the combination,

(ii) the equivalent resistance of the combination, and

(iii) the potential difference between the points A and B.



[2012]

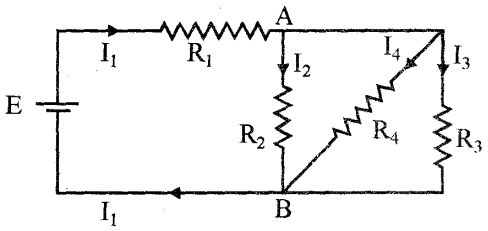
Q73. Two heating elements of resistances R_1 and R_2 when operated at a constant supply of voltage, V, consume powers P_1 and P_2 respectively. Deduce the expressions for the power of their combination when they are, in turn, connected in (i) series and (ii) parallel across the same voltage supply.

[2011]

Q74. Define the terms (i) drift velocity, (ii) relaxation time. A conductor of length L is connected to a dc 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?

[2011 • Set 55-1-1]

Q75. In the circuit shown, $R_1 = 4\ \Omega$, $R_2 = R_3 = 15\ \Omega$, $R_4 = 30\ \Omega$ and $E = 10$ V. Calculate the equivalent resistance of the circuit and the current in each resistor.



[2011 • Set 55-1-1]

Q76. State the underlying principle of a potentiometer. Describe briefly, giving the necessary circuit diagram, how a potentiometer is used to measure the internal resistance of a given cell.

[2011 • Set 55-2-1]

Q77. 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 given cell.

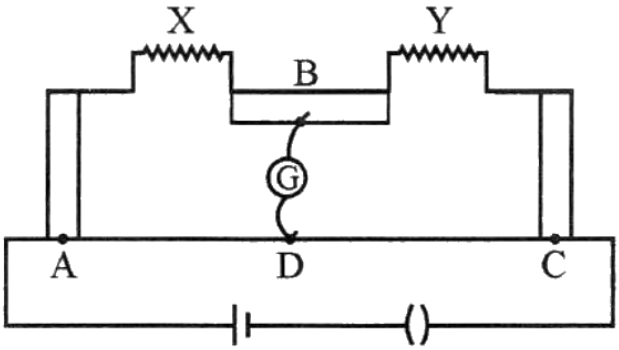
[2010]

Q78. In a meter bridge, the null point is found at a distance of 40 cm from A. If a resistance of 12 Ω is connected in parallel with S, the null point occurs at 50.0 cm from A. Determine

the values of R and S.

[2010]

Q79.

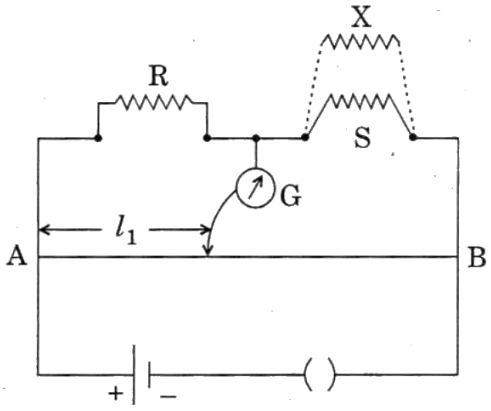


The figure shows experimental set up of a meter bridge. When the two unknown resistances X and Y are inserted, the null point D is obtained $40\ cm$ from the end A. When a resistance of $10\ \Omega$ is connected in series with X, the null point shifts by $10\ cm$. Find the position of the null point when the $10\ \Omega$ resistance is instead connected in series with resistance Y. Determine the values of the resistances X and Y.

[2009]

Q80. **(i)** State the principle of working of a meter bridge.

(ii) In a meter 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_2. Find the expression for X in terms of l_1, l_2 and S.



[2009]

Q81. Prove that the current density of a metallic conductor is directly proportional to the drift speed of electrons.

[2008]

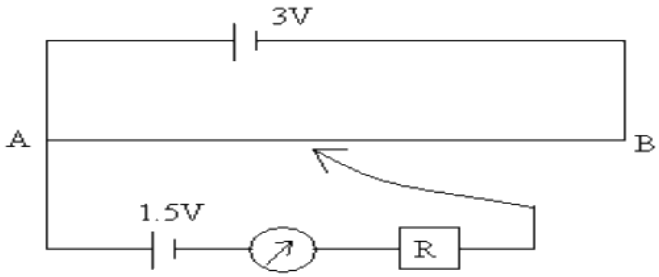
Q82. A number of identical cells, n, each of emf E, internal resistance r connected in series are charged by a d.c source of emf E', using a resistor R.

(i) Draw the circuit arrangement.

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

[2008]

Q83. A potentiometer wire of length $1\ m$ is connected to a driver cell of emf $3\ V$ as shown in the figure. When a cell of emf $1.5\ V$ 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 drive cell is replaced with a cell emf $1\ V$.

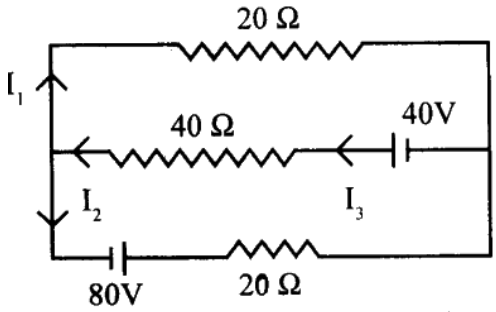
(iii) Does the high resistance R, used in the secondary circuit affect the balance point? Justify your answer.

[2008]

Q84. A resistance $R = 5\ \Omega$ is connected to one of the gaps in a meter bridge, which uses a wire of length $1\ m$. An unknown resistance $X > 5\ \Omega$ is connected in the other gap as shown in the figure. The balance point is noticed at 'l' cm from the positive end of the battery. On interchanging R and X, it was found that the balance point shifts by $20\ cm$ away from end A. Neglecting the end correction, calculate the value of unknown resistance X used.

[2008]

Q85. 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 given below.

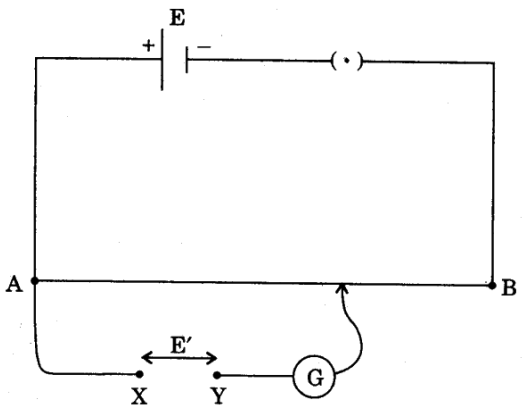


[2007]

Q86. Write the mathematical relation for the resistivity of a material in terms of relaxation time, number density and mass and charge of charge carriers in it. Explain, using this relation, why the resistivity of a metal increases and that of a semi-conductor decreases with rise in temperature.

[2007]

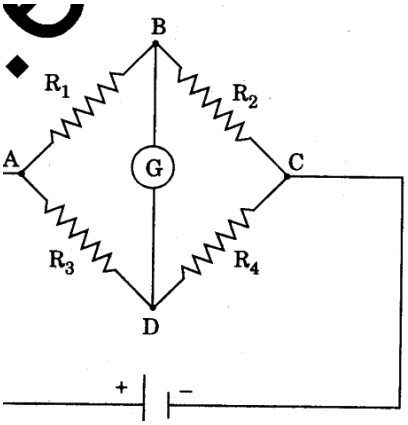
Q87. For the potentiometer circuit shown in the given figure, points X and Y represent the two terminals of an unknown emf E'. A student observed that when the jockey is moved from the end A to the end B of the potentiometer wire, the deflection in the galvanometer remains in the same direction.



What may be the two possible faults in the circuit that could result in this observation? If the galvanometer deflection at the end B is (i) more, (ii) less, than that at 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.

[2007]

Q88. The given figure shows a network of resistances R_1, R_2, R_3 and R_4.



Using Kirchhoff's laws, establish the balance condition for the network.

[2007]

Q89. What is Seebeck effect? Plot a graph showing the variation of thermo emf with temperature of hot junction (keeping cold junction at $0°C$) of a thermocouple. How will the (i) neutral temperature, (ii) inversion temperature of a thermocouple change when the temperature of cold junction is increased?

[2007]

Q90. A $10\ \text{m}$ long wire of uniform cross-section and resistance $20\ \Omega$ is used in a potentiometer. The wire is connected in series with a battery of $5\ \text{V}$ along with an external resistance of $480\ \Omega$. If an unknown emf E is balanced at $6.0\ \text{m}$ length of the wire, calculate:

(i) the potential gradient of the potentiometer wire,

(ii) the value of the unknown emf E.

[2006]

Q91. Define the term 'resistivity' and write its S.I. unit. Derive the expression for the resistivity of a conductor in terms of number density of free electrons and relaxation time.

[2005]

Q92. State the principle of potentiometer. Draw a circuit diagram used to compare the e.m.f. of two primary cells. Write the formula used. How can the sensitivity of a potentiometer be increased?

[2005]

Q93. What is meant by 'drift velocity of free electrons'? Derive Ohm's law on the basis of the theory of electron drift.

[2003]

Q94. What is Wheatstone bridge? Deduce the condition for which Wheatstone bridge is

balanced.

[2003]

Q95. What is meant by the sensitivity of a potentiometer? A battery E_1 of 4 V and a variable resistance R_1 are connected in series with the wire AB of the potentiometer. The length of the wire of the potentiometer is 1 metre. When a cell E_2 of e.m.f. 1.5 volt is connected between points A and C, no current flows through E_2. Length of AC = 60 cm.

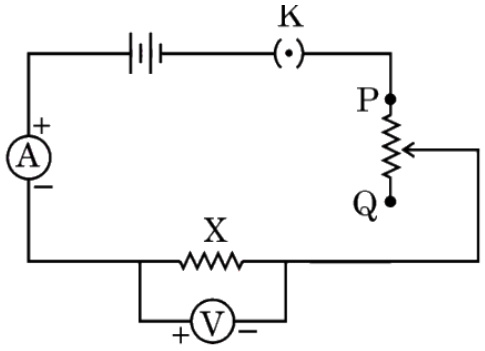
(i) Find the potential difference between the ends A and B of the potentiometer,

(ii) Would the method work, if the battery E_1 is replaced by a cell of e.m.f. of 1 V?

[2003]

4-Mark Questions (2 questions · Section D · Case Study)

Q1. A student sets up the circuit as shown in the figure to find the value of unknown resistance X and records a set of readings of the voltmeter and the ammeter by using the rheostat.



[2026 • Set 55-4-1]

Q2. During a thunderstorm the 'live' wire of the transmission line fell down on the ground from the poles in the street. A group of boys, who passed through, noticed it and some of them wanted to place the wire by the side. As they were approaching the wire and trying to lift the cable, Anuj noticed it and immediately pushed them away, thus preventing them from touching the live wire. During pushing some of them got hurt. Anuj took them to a doctor to get them medical aid. Based on the above paragraph, answer the following questions:

(a) Write the two values which Anuj displayed during the incident.

(b) Why is it that a bird can sit on a suspended 'live' wire without any harm whereas touching it on the ground can give a fatal shock?

(c) The electric power from a power plant is set up to a very high voltage before transmitting it to distant consumers. Explain, why.

[2015]

5-Mark Questions (16 questions · Section E · Long Answer)

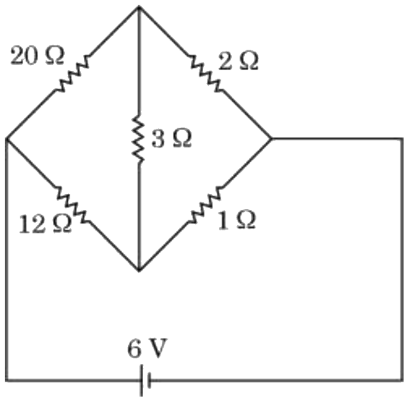
Q1. (a) An electric field $\vec{E}$ is established across the ends of a cylindrical conductor of length L and area of cross-section A. Discuss how electrons attain an average velocity, independent of time. Hence, obtain a relation between current in the conductor and this 'average velocity' of electrons.

[2026 • Set 55-2-1]

Q2. (b) (i) This 'average velocity' is found to be a few mm s^{-1} for currents in range of a few amperes. How then is current established almost the instant a circuit is closed? (ii) Two copper wires having their radii in the ratio of $3 : 2$ are connected in series across a battery. Find the ratio of the drift velocities of the electrons in the wires.

[2026 • Set 55-2-1]

Q3. (a) (i) Derive the condition for which a Wheatstone Bridge is balanced. (ii) Determine the current in $3\,\Omega$ branch of a Wheatstone Bridge in the circuit shown in the figure.

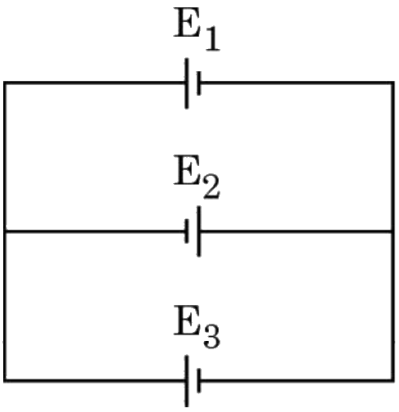


[2026 • Set 55-5-1]

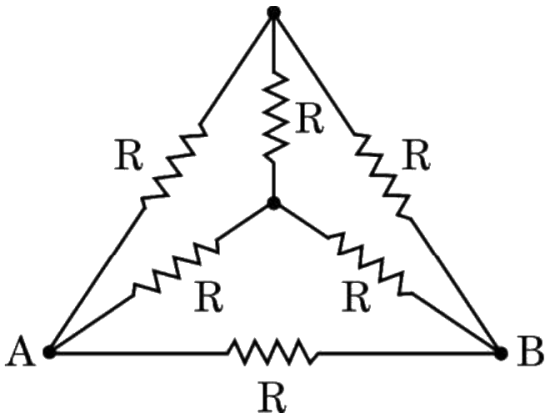
Q4. (b) (i) Consider a cylindrical conductor of length l and area of cross-section A. Current I is maintained in the conductor and electrons drift with velocity $\vec{v_d}$ $\left(|\vec{v_d}| = \dfrac{e|\vec{E}|}{m}\tau\right)$, (where symbols have their usual meanings). Show that the conductivity σ of the material of the conductor is given by $\sigma = \dfrac{ne^2\tau}{m}$. (ii) The resistance of a metal wire at $20°$C is $1.05\,\Omega$ and at $100°$C is $1.38\,\Omega$. Determine the temperature coefficient of resistivity of this metal.

[2026 • Set 55-5-1]

Q5. (a) (i) Three batteries E_1, E_2 and E_3 of emfs and internal resistances $(4\text{ V}, 2\,\Omega)$, $(2\text{ V}, 4\,\Omega)$ and $(6\text{ V}, 2\,\Omega)$ respectively are connected as shown in the figure. Find the values of the currents passing through batteries E_1, E_2 and E_3.

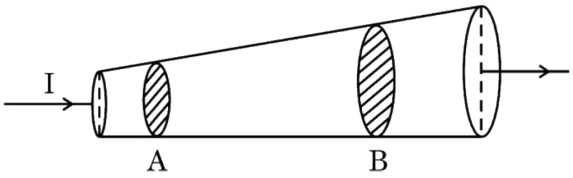


(ii) The ends of six wires, each of resistance $R\ (=10\ \Omega)$ are joined as shown in the figure. The points A and B of the arrangement are connected in a circuit. Find the value of the effective resistance offered by it to the circuit.



OR

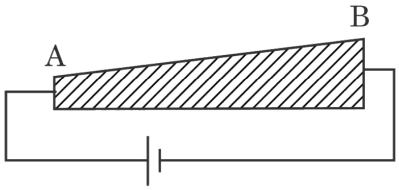
(b) (i) Current $I\ (=1\ \text{A})$ is passing through a copper rod $(n = 8.5 \times 10^{28}\ \text{m}^{-3})$ of varying cross-sections as shown in the figure. The areas of cross-section at points A and B along its length are $1.0 \times 10^{-7}\ \text{m}^2$ and $2.0 \times 10^{-7}\ \text{m}^2$ respectively. Calculate: (I) the ratio of electric fields at points A and B. (II) the drift velocity of free electrons at point B.



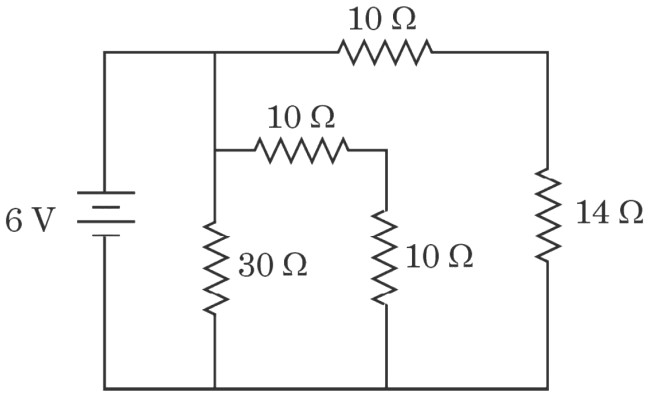
(ii) Two point charges $q_1\ (=16\ \mu\text{C})$ and $q_2\ (=1\ \mu\text{C})$ are placed at points $\vec{r}_1 = (3\ \text{m})\hat{i}$ and $\vec{r}_2 = (4\ \text{m})\hat{j}$. Find the net electric field $\vec{E}$ at point $\vec{r} = (3\ \text{m})\hat{i} + (4\ \text{m})\hat{j}$.

[2025 • Set 55-5-1]

Q6. (a) (i) Define mobility of electrons. Give its SI units. (ii) A steady current flows through a wire AB, as shown in the figure. What happens to the electric field and the drift velocity along the wire? Justify your answer.

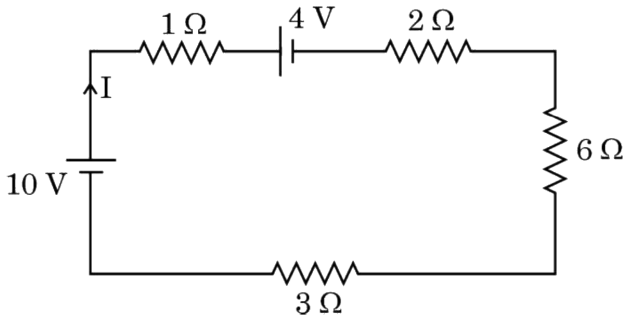


(iii) Consider the circuit shown in the figure. Find the effective resistance of the circuit and the current drawn from the battery.



OR

(b) (i) Define electrical conductivity of a wire. Give its SI unit. (ii) High current is to be drawn safely from (1) a low-voltage battery, and (2) a high-voltage battery. What can you say about the internal resistance of the two batteries? (iii) Calculate the total energy supplied by the batteries to the circuit shown in the figure, in one minute.



[2023 • Set 55-4-1]

Q7. (a) (i) Explain how free electrons in a metal at constant temperature attain an average velocity under the action of an electric field. Hence obtain an expression for it. (ii) Consider two conducting wires A and B of the same diameter but made of different materials joined in series across a battery. The number density of electrons in A is 1.5 times that in B. Find the ratio of drift velocity of electrons in wire A to that in wire B.

OR

(b) (i) A cell of emf (E) and internal resistance (r) is connected across a variable load

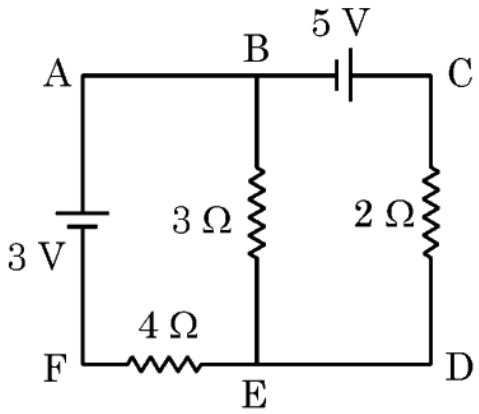
resistance (R). Draw plots showing the variation of terminal voltage V with (i) R and (ii) the current (I) in the load. (ii) Three cells, each of emf E but internal resistances 2r, 3r and 6r are connected in parallel across a resistor R. Obtain expressions for (i) current flowing in the circuit, and (ii) the terminal potential difference across the equivalent cell.

[2023 • Set 55-5-1]

Q8. (a) Describe briefly, with the help of a circuit diagram, the method of measuring the internal resistance of a cell.

(b) Give reason why a potentiometer is preferred over a voltmeter for the measurement of emf of a cell.

(c) In the potentiometer circuit given below, calculate the balancing length l. Give reason, whether the circuit will work, if the driver cell of emf $5\,V$ is replaced with a cell of $2\,V$, keeping all other factors constant.

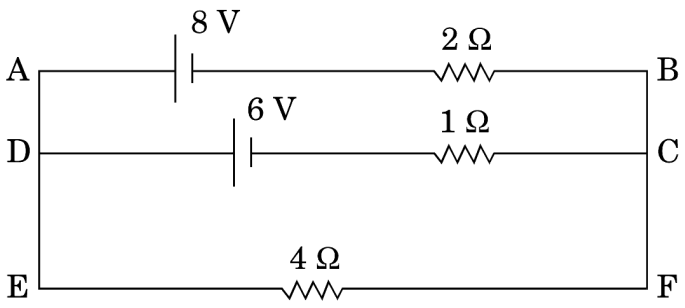


OR

(a) State the working principle of a meter bridge used to measure an unknown resistance.

(b) Give reason (i) why the connections between the resistors in a metre bridge are made of thick copper strips, (ii) why is it generally preferred to obtain the balance length near the mid-point of the bridge wire.

(c) Calculate the potential difference across the $4\,\Omega$ resistor in the given electrical circuit, using Kirchhoff's rules.



[2019 • Set 55-2-1]

Q9. (a) Derive a relation between the internal resistance, emf and terminal potential difference of a cell from which current I is drawn. Draw V vs I graph for a cell and explain its significance.

(b) A voltmeter of resistance $998\,\Omega$ is connected across a cell of emf 2 V and internal resistance $2\,\Omega$. Find the potential difference across the voltmeter and also across the terminals of the cell. Estimate the percentage error in the reading of the voltmeter.

OR

(a) Two cells of different emfs and internal resistances are connected in parallel with one another. Derive the expression for the equivalent emf and equivalent internal resistance of the combination.

(b) Two identical cells of emf 1.5 V and internal resistance r are each connected in parallel providing a supply to an external circuit consisting of two resistances of $17\,\Omega$ each joined in parallel. A very high resistance voltmeter reads the terminal voltage of the cell to be 1.4 V. Calculate the internal resistance of each cell.

[2019 • Set 55-5-1]

Q10. (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

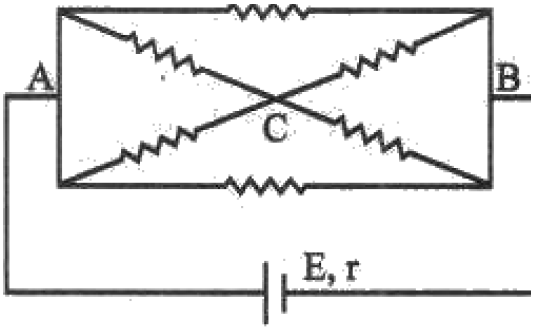
(c) electric current

(d) electric field Justify your answer.

OR

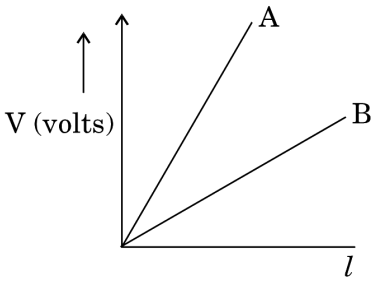
(i) State the two Kirchhoff's laws. Explain briefly how these rules are justified.

(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 figure. Obtain the expression for (i) the current draw from the cell and (ii) the power consumed in the network.



[2017]

Q11. (a) (i) State the principle on which a potentiometer works. How can a given potentiometer be made more sensitive? (ii) In the graph shown below for two potentiometers, state with reason which of the two potentiometers, A or B, is more sensitive.



(b) Two metallic wires, P_1 and P_2 of the same material and same length but different cross-sectional areas, A_1 and A_2 are joined together and connected to a source of emf. Find the ratio of the drift velocities of free electrons in the two wires when they are connected (i) in series, and (ii) in parallel.

OR

(a) Define the capacitance of a capacitor. Obtain the expression for the capacitance of a parallel plate capacitor in vacuum in terms of plate area A and separation d between the plates.

(b) A slab of material of dielectric constant K has the same area as the plates of a parallel plate capacitor but has a thickness $\frac{d}{2}$. Find the ratio of the capacitance with dielectric inside it to its capacitance without the dielectric.

[2017]

Q12. (i) State the principle of working of a meter bridge. Draw the circuit diagram for finding an unknown resistance using a meter bridge. Derive the relevant formula used.

(ii) In a meter bridge with R and S in the gaps, the null point is found at 40 cm from A. If a resistance of $30\,\Omega$ is connected in parallel with S, the null point occurs at 50 cm

from A. Determine the values of R and S.

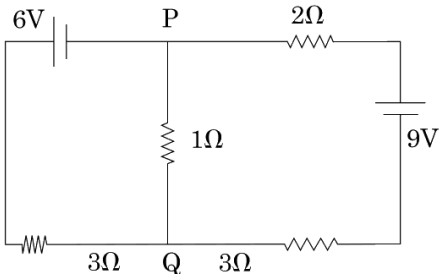
OR

(a) Deduce the expression for the torque acting on a dipole of dipole moment $\vec{P}$ placed in a uniform electric field $\vec{E}$. Depict the direction of the torque. Express it in the vector form.

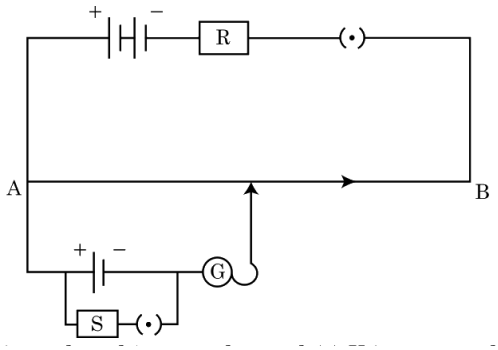
(b) Show that the potential energy of a dipole making angle θ with the direction of the field is given by $u(\theta) = -\vec{p} \cdot \vec{E}$. Hence find out the amount of work done in rotating it from the position of unstable equilibrium to the stable equilibrium.

[2016]

Q13. (i) Find the magnitude and direction of current in $1\ \Omega$ resistor in the given circuit.



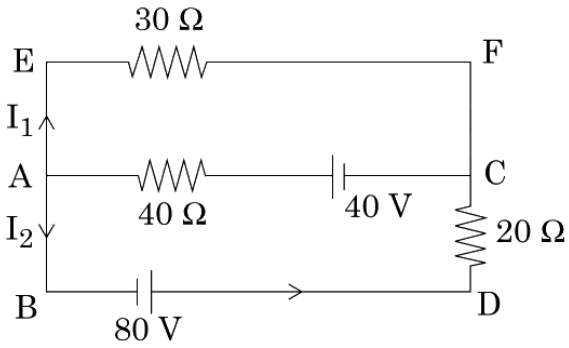
(ii) Two students X and Y perform an experiment on potentiometer separately using the circuit diagram shown below.



Keeping other things unchanged (a) X increases the value of resistance R, (b) Y decreases the value of resistance S in the set up. How will these changes affect the position of null point in each case and why?

OR

(a) Use Kirchhoff's rules, calculate the current in the arm AC of the given circuit.



(b) On what principle does the meter bridge work? Why are the metal strips used in the bridge?

[2016]

Q14. (a) State Kirchhoff's rules and explain on what basis they are justified.

(b) Two cells of emfs E_1 and E_2 and internal resistances r_1 and r_2 are connected in parallel. Derive the expression for the (i) emf and (ii) internal resistance of a single equivalent cell which can replace this combination.

[2015]

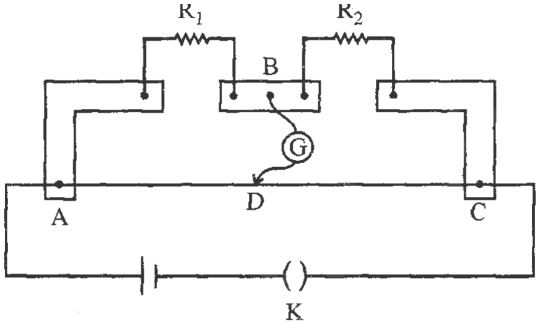
Q15. (a) State the working principle of a potentiometer. With the help of the circuit diagram, explain how a potentiometer is used to compare the emf's of two primary cells. Obtain the required expression used for comparing the emfs.

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

OR

(a) State Kirchhoff's rules for an electric network. Using Kirchhoff'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 figure, the null point 'D' is obtained at a distance of 40 cm from end A of the meterbridge wire. If a resistance of $10\,\Omega$ is connected in series with R_1, null point is obtained at $AD = 60$ cm. Calculate the values of R_1 and R_2.



[2013]

Q16. Deduce the condition for balance in a Wheatstone Bridge. Using the principle of Wheatstone Bridge, describe the method to determine the specific resistance of a wire in the laboratory. Draw the circuit diagram and write the formula used. Write any two important precautions to observe while performing the experiment.

[2004]