	INDIAN SCHOOL AL WADI AL KABIR	
Class: XII	**Department: SCIENCE 2026 – 27** **SUBJECT: PHYSICS**	**Date: 02/05/2026**
Worksheet No: 03 **WITH ANSWERS**	**CHAPTER: 3 CURRENT ELECTRICITY**	**Note:** **A4 FILE FORMAT**
NAME OF THE STUDENT	**CLASS & SEC:**	**ROLL NO.**

SECTION – A
MCQ BASED QUESTIONS

1. 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 wire Q will be

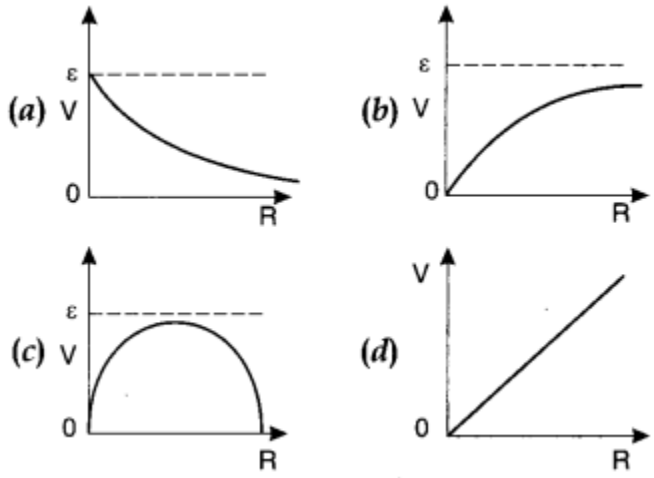
(a) R (b) $\frac{R}{2}$ (c) $\frac{R}{8}$ (d) 2R

2. In the equation AB = C, A is the current density, C is the electric field, Then B is
(a) resistivity
(b) conductivity
(c) potential difference
(d) resistance

3. The drift velocity of electrons is due to
(a) motion of conduction electrons due to random collisions.
(b) motion of conduction electrons due to the electric field E
(c) repulsion to the conduction electrons due to the inner electrons of ions.
(d) collision of conduction electrons with each other.

4. A cell having an emf E and internal resistance r is connected across a variable external resistance R. As the resistance R is increased, the plot of potential difference V across R is given

by



5. In a parallel combination of n cells, we obtain
(a) more voltage
(b) more current
(c) less voltage
(d) less current

6. If n cells each of emf e and internal resistance r are connected in parallel, then the total emf and internal resistance will be

(a) $\varepsilon, \frac{r}{n}$ (b) ε, nr

(c) $n\varepsilon, \frac{r}{n}$ (d) $n\varepsilon, nr$

7. In a Wheatstone bridge, if the battery and galvanometer are interchanged, then the deflection in the galvanometer will
(a) change in previous direction
(b) not change
(c) change in the opposite direction
(d) None of these.

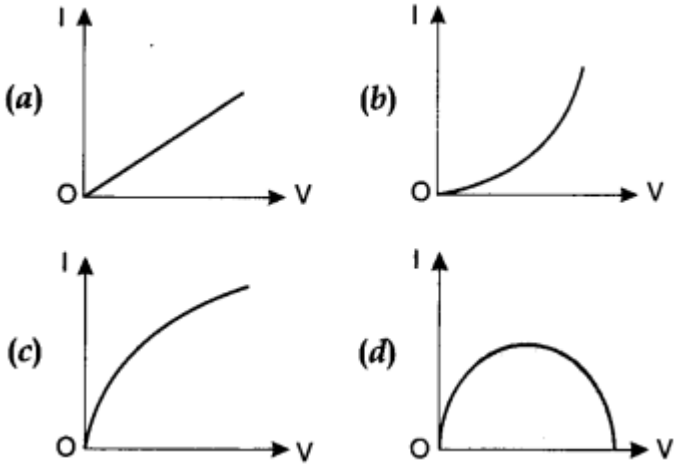
8. When a metal conductor connected to left gap of a meter bridge is heated, the balancing point
(a) shifts towards right
(b) shifts towards left
(c) remains unchanged
(d) remains at zero

9. The relaxation time in conductors
(a) increases with the increase in temperature
(b) decreases with the increase in temperature
(c) it does not depend on temperature
(d) all of a sudden changes at 400 K

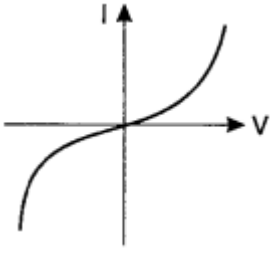
10. The example of non-ohmic resistance is
(a) diode (b) copper wire
(c) filament lamp (d) carbon resistor

11. A charge is moving across a junction, then
(a) momentum will be conserved.
(b) momentum will not be conserved.
(c) At some places, momentum will be conserved, and at some other places, momentum will not be conserved.
(d) None of these.

12. Which of the following I-V graph represents an ohmic conductor?

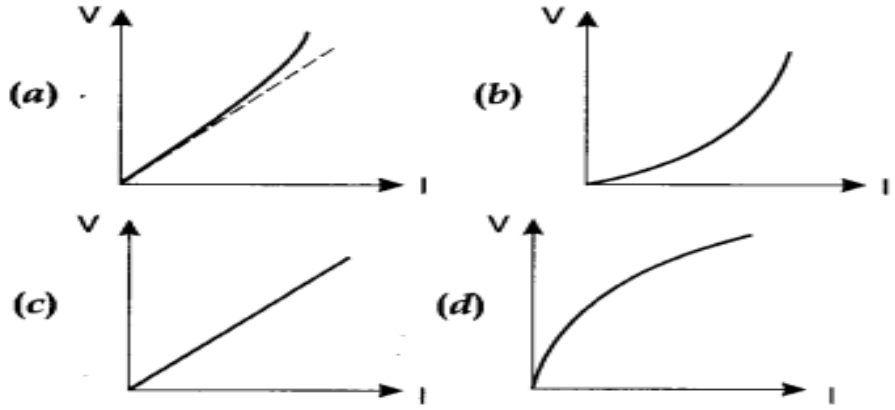


13. The I-V characteristics shown in the figure represent



(a) ohmic conductors (b) non-ohmic conductors
(c) insulators (d) superconductors

14. Which of the following is correct for the V-I graph of a good conductor?



15. The resistivity of alloy manganin is
(a) Nearly independent of temperature
(b) Increases rapidly with increase in temperature
(c) Decreases with increase in temperature
(d) Increases rapidly with decrease in temperature

16. A galvanometer of resistance 27Ω is converted into an ammeter of range (0-10mA) using a resistance of 3 Ω. The galvanometer will show full-scale deflection for a current of about
(BBQ – 2025-26)
(a) 10 mA (b) 100 mA (c) 1 mA (d) 3mA

17. Ohm's law is true for
(a) For metallic conductors at low temperature.
(b) For metallic conductors at high temperature.
(c) for electrolytes when current passes through them.
(d) For diode when current flows.

18. In an experiment of the meter Bridge, a null point is obtained at the centre of the bridge wire. When a resistance of 10 Ω is connected in one gap, the value of resistance in the other gap is
(a) 10 Ω (b) 5 Ω (c) 15 Ω (d) 50 Ω

19. The Terminal potential difference of a cell is greater than its e.m.f when it is
(a) Being discharged. (b) In an open circuit.
(c) Being charged. (d) Being either charged or discharged.

20. A fuse wire is a wire of
(a) Both low resistance and low melting point.
(b) High resistance and low melting point.
(c) Low resistance and high melting point.
(d) Both high resistance and high melting point.

21. In India, electricity is supplied for domestic use at 220 V. It is supplied at 110 V in U.S.A. If the resistance of a 60 W bulb for use in India is R Ω, then the resistance of a 60 W bulb for use in the U.S.A. will be

(a) R Ω. (b) 2R Ω. (c) R/4 Ω. (d) R/2 Ω.

22. A wire of resistance 10 Ω is elongated by 10 %. The resistance of the elongated wire is

(a) 10.1 Ω. (b) 11.1 Ω. (c) 12.1 Ω. (d) 13.1 Ω.

23. Which of the following physical quantities possesses the dimensions of $M^{-1}L^{-3}T^{3}A^{2}$?

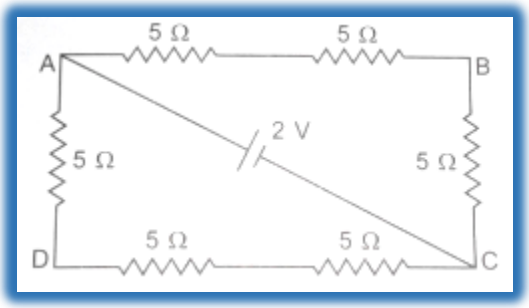
(a) resistance. (b) resistivity. (c) conductivity. (d) emf.

24. Given a current-carrying wire of non-uniform cross section. Which of the following is constant throughout the length of the wire?

(a) current, electric field and drift speed (b) current and drift speed

(c) drift speed only (d) current only

25. The potential difference between points A and B of the given figure is……...



(a) 2/3 V (b) 4/3 V

(c) 8/3 V (d) 0 V

SECTION B (2 MARKS QUESTIONS)

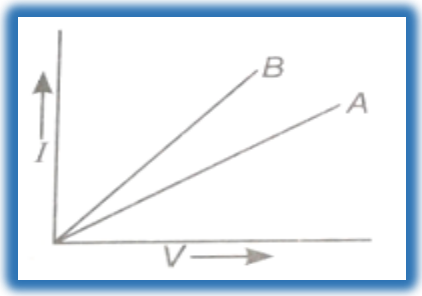
26. Two conducting wires X and Y of the same diameter across a battery. If the number density of electrons in X is twice that in Y, find the ratio of the drift velocity of electrons in the two wires.

27. An electric bulb is rated 220 V and 100 W. Find the power consumed by it when operated on 110 V.

28. Calculate the temperature at which the resistance of a conductor becomes 20% more than its resistance at 27ºC. The value of the temperature coefficient of resistance of the material of conductor is $2.0 \times 10^{-4}\ ^{o}C^{-1}$. **(BBQ – 2025-26)**

29. Two materials Si and Cu are cooled from 300 K to 60 K. What will be the effect on their resistivity?

30. Out of *V* - *I* graph for parallel and series combination of two metallic resistors, which one represents parallel combination of resistors? Justify your answer.



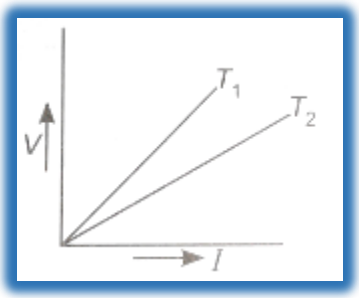
31. It is easier to start a car engine on a warm day than on a chilly day. Why?
32. A wire of resistivity ρ is stretched to double its length. What will be its new resistivity? Explain with reason.

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

SECTION – C (3 MARKS QUESTIONS)

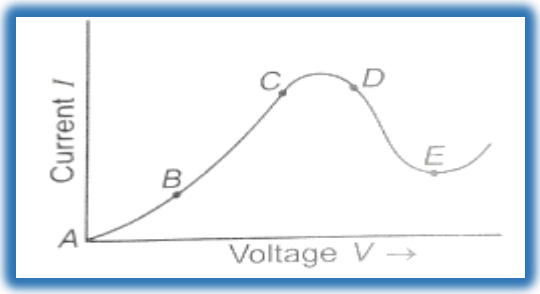
34.(a) Plot a graph showing the variation of resistance of a conducting wire as a function of its radius, keeping the length of the wire and its temperature constant.

(b) V – I graph for a metallic wire at two different temperatures, T_1 and T_2 is shown in the figure. Which of the two temperatures is higher and why?

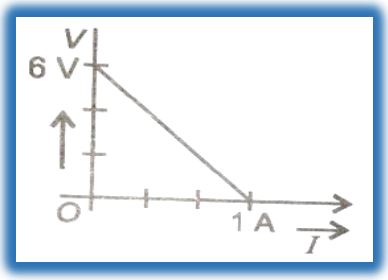


35. (a)Differentiate between EMF and terminal potential difference. The EMF of a cell is always greater than its terminal voltage. Why? Give a reason.
(b) You are given three constantan wires P, Q and R of length and area of cross-section (L, A), (2L, A/2), (L/2, 2A) respectively. Which has higher resistance? Why?

36. (a) A graph showing the variation of current vs voltage for a material, GaAs is shown in the figure. Identify the region of
(i) negative resistance.
(ii) where Ohm's law is obeyed.
(b) Give an example of a material for which the temperature coefficient of resistivity is (i) positive and (ii) negative.



37. (a) Show the variation of resistivity of copper as a function of temperature in a graph.
(b) The plot of the variation of potential difference across a combination of three identical cells in series, versus a current, is as shown here. What is the EMF of each cell and the internal resistance of each cell?

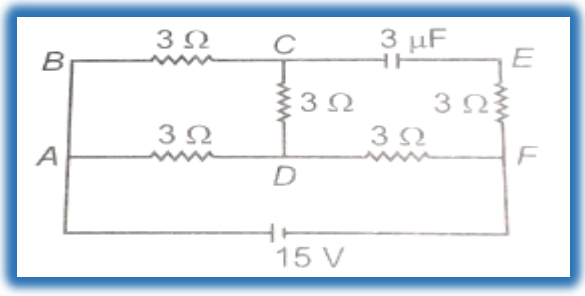


38. a) Two wires of equal length, one of copper and the other of manganin, have the same resistance. Which wire is thicker?
(b) Write two characteristics of manganin which make it suitable for making standard resistances.

39. Define the mobility of electrons in a conductor. How does electron mobility change when
(i) temperature of the conductor is decreased?
(ii) and applied potential difference is doubled at constant temperature?

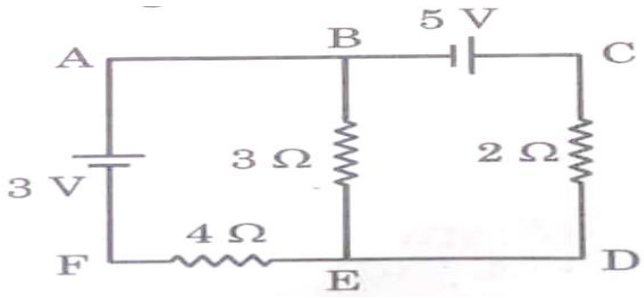
40. State the two Kirchhoff's rule used in electric networks. How are these rules justified?

41) In the circuit shown in the figure, find the total resistance of the circuit and the current in the arm CD.

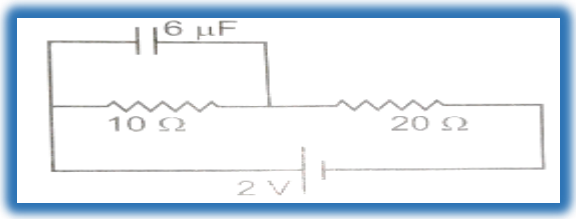


42) (a) Explain the statement: " Current is scalar although we represent current with an arrow"

(b) Use Kirchhoff's rules to find the current through 3Ω resistor in the circuit shown in the figure: **(BBQ – 2025-26)**

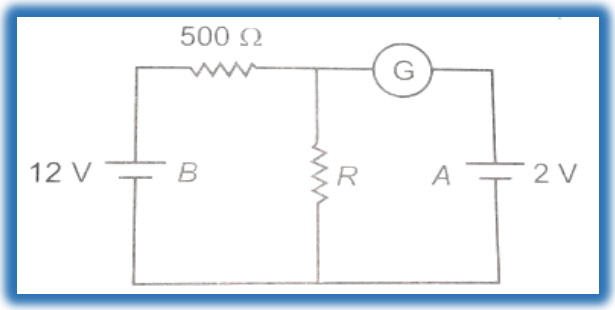


43) Find the charge on the capacitor as shown in the circuit.

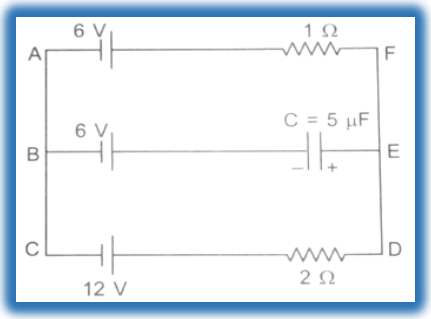


SECTION – D (5 MARKS QUESTIONS)

44) In the circuit shown in the figure, the galvanometer G gives zero deflection. If the batteries A and B have negligible internal resistance, find the value of the resistor R.



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



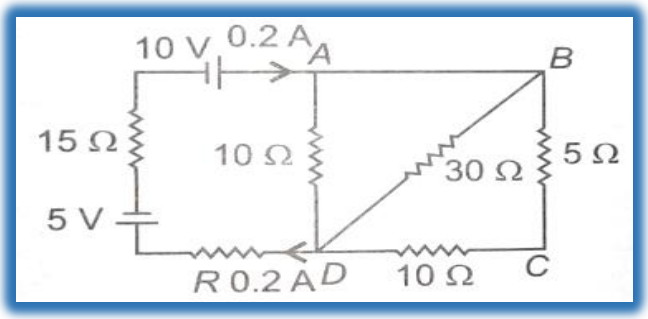
46) First, a set of '*n*' equal resistors of 'R' each are connected in series to a battery of emf 'E' and internal resistance 'R'. A current *I* is observed to flow. Then the *n* resistors are connected in

parallel to the same battery. It is observed that the current has increased by a factor of 10. What is n?

47. The heating element is marked 210 V, 630 W. What is the value of the current drawn by the element when connected to a 210 V DC source and also find the resistance of the heating element?

48. An emf of a cell is 1.5 V, and its internal resistance is 1 Ω. For what current drawn from the cell will its terminal potential difference be half of its emf?

49. Calculate the value of the resistance R in the circuit shown in the figure so that the current in the circuit is 0.2 A. What would be the potential difference between points A and D? **(BBQ)**



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

(ii) Cross-sectional area is increasing linearly from one end to the other and is connected across a battery of V volts. Which of the following quantities remains constant in the wire?

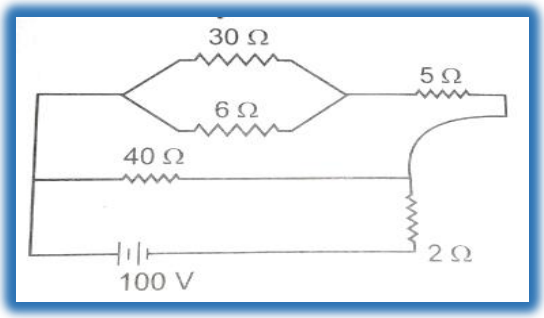
(a)drift speed (b)current density

(c)electric current (d) electric field

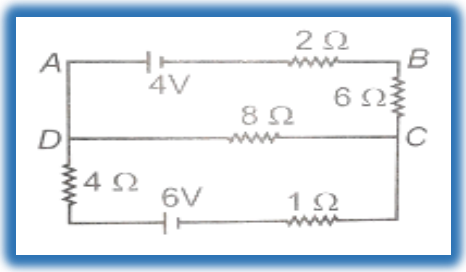
Justify your answer.

51. (a) Define the term drift velocity of charge carriers in a conductor. Obtain the expression for the current density in terms of relaxation time.

(b) A 100 V battery is connected to the electric network as shown. If the power consumed in the 2 Ω resistor is 200 W, determine the power dissipated in the 5 Ω resistor.

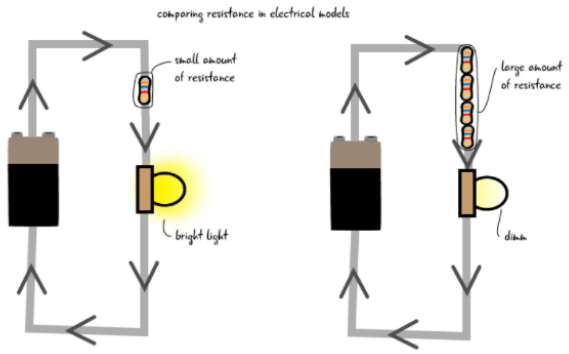


52) (a) State Kirchhoff's law of an electrical network. (b) Using Kirchhoff's laws, Calculate the potential difference across the 8 Ω resistor.



CASE STUDY BASED QUESTIONS

53) Read the following source and answer any four out of the following questions:
Resistance is a measure of the opposition to current flow in an electrical circuit. Resistance is measured in ohms. Also, Resistivity the electrical resistance of a conductor of unit cross-sectional area, and unit length. A characteristic property of each material, resistivity is useful in comparing various materials on the basis of their ability to conduct electric currents.



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1) Resistivity is independent of:

a) nature of material

b) temperature

c) dimensions of material

d) none of the above

2) As compared to short wires, long wires of the same cross section and material have _____ resistance.

a) more

b) less

c) same

d) zero

3)As compared to thin wires, thick wires of the same length and material have _____ resistance.

a) more
b) less
c) same
d) zero

4)The resistance of a wire depends upon:

a) cross-sectional area

b) length of wire

c) wire's nature

d) all of the above

5)A copper wire having the same size as a steel wire has:

a) more resistance

b) less resistance

c) same resistance

d) none of the above

54. ASSERTION REASONING QUESTIONS

Directions: These questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you are required to choose one of the following four responses.
(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct, but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but the reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

Q.1. Assertion: In a simple battery circuit, the point of the lowest potential is the positive terminal of the battery.
Reason: The current flows towards the point of the higher potential, as it does in such a circuit from the negative to the positive terminal.

Q.2. Assertion: A larger dry cell has a higher emf.
Reason: The emf of a dry cell is proportional to its size.

Q.3. Assertion: Voltmeter is connected in parallel with the circuit.
Reason: The resistance of a voltmeter is very large.

Q.4. Assertion: Ohm's law is applicable to all conducting elements.
Reason: Ohm's law is a fundamental law.

Q.5. Assertion: An electric bulb becomes dim when the electric heater in a parallel circuit is switched on.
Reason: Dimness decreases after some time.

Q.6. Assertion: 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 50W bulb is maximum. **(BBQ)**

Reason: In a series circuit, current is the same through each bulb, but the potential difference across each bulb is different.

Q.7. Assertion: A high voltage (high tension) supply must have very large internal resistance.

Reason: If the circuit is accidentally shorted, then the current drawn will not exceed safely if the internal resistance is high.

ANSWERS

1. (c) $\frac{R}{8}$

$$R = \rho \frac{L}{\pi \frac{d^2}{4}} = \frac{4\rho L}{\pi d^2}$$

$$R_Q = \frac{4\rho L_Q}{\pi d_Q^2}$$

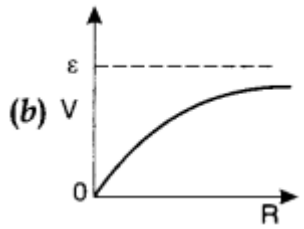
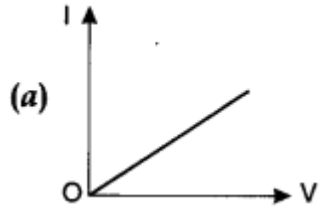
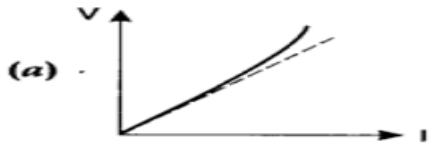
$$R_Q = \frac{4\rho(\frac{L_P}{2})}{\pi(2d_P)^2}$$

$$R_Q = \frac{2\rho L_P}{\pi(4d_P^2)}$$

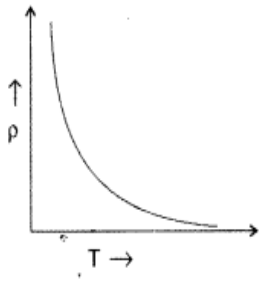
$$R_Q = \frac{1}{8}\left(\frac{4\rho L_P}{\pi d_P^2}\right)$$

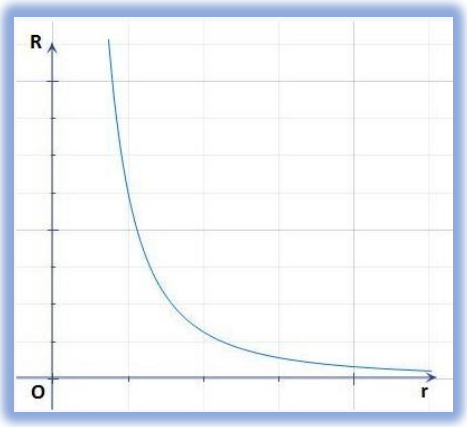
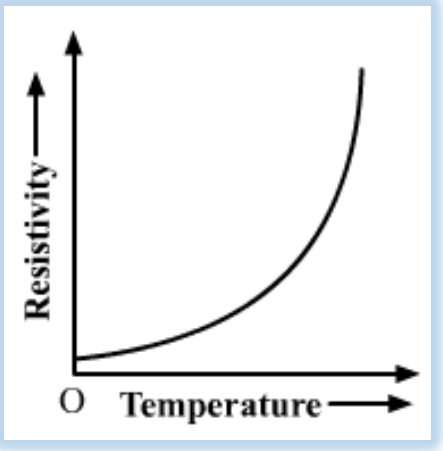
Since the term in parentheses is the resistance of wire P (R), we find:

$$R_Q = \frac{1}{8} R$$

2.	Answer- a Explanation: $J = \sigma E \Rightarrow J\rho = E$ J is current density, E is electric field so B = ρ = resistivity.
3.	(b) motion of conduction electrons due to electric field E
4.	
5.	(b) more current
6.	(a) $\varepsilon, \frac{r}{n}$
7.	(b) not change
8.	(a) shifts towards right When resistor is heated its resistance increases hence the balancing point will shift towards right.
9.	(b) decreases with the increases of temperature
10	(a) diode
11	(d) none of these.
12	
13	(b) non-ohmic conductors
14	
15	(a) Nearly independent of temperature
16	$I_g = \frac{S \cdot I}{G + S}$

	$I_g = \frac{3 \cdot 10}{27 + 3}$ $I_g = \frac{30}{30}$ $I_g = 1.0\ \text{mA}$
17	(a) For metallic conductors at low temperature.
18	(a) 10 Ω $\frac{R}{S} = \frac{l}{100 - l}$
19	(c) Being charged.
20	(b) High resistance and low melting point.
21	(c) R/4 Ω. Hints: - $R = V^2/P$.
22	(c) 12.1 Ω. Hints: -$R = \rho\ l/A = \rho l^2/Al = \rho l^2/V$, $R \propto l^2$.
23	(c) conductivity.
24	(d) current only
25	(b)(4/3 V) Hints: - total resistance = 15/2 ohm. Current through each branch = 2/15 A. V_{AB} = I X resistance of AB. = 2/15 x 10 = 4/3 volt.
	SECTION B (2 MARKS QUESTIONS)
26	$I = neA\ v_d \qquad \therefore \frac{v_{d_x}}{v_{d_y}} = \frac{n_y}{n_x}$ $\text{As } n_x = 2n_y \qquad \therefore \frac{v_{d_x}}{v_{d_y}} = \frac{1}{2}$

27	$P = V^2/R$ $100\ W = 220^2/R$ $R = 220^2/100\ \Omega = 484\ \Omega.$ **Resistance of the bulb**=484 Ω When V = 110 V power consumed = $V^2/R = 110^2/484 = 25$ W.
28	$R_2 = R_1[1 + \alpha(T_2 - T_1)]$ $1.2R_1 = R_1[1 + (2.0 \times 10^{-4})(T_2 - 27)]$ Divide both sides by R_1: $1.2 = 1 + (2.0 \times 10^{-4})(T_2 - 27)$ Subtract 1 from both sides: $0.2 = (2.0 \times 10^{-4})(T_2 - 27)$ Solve for $(T_2 - 27)$: $T_2 - 27 = \frac{0.2}{2.0 \times 10^{-4}} = 1000$ Finally, add the initial temperature: $T_2 = 1000 + 27 = 1027°C.$
29	The specific **resistivity** of copper (metal) **will** decrease but that of **silicon** (semi-conductor) **will** increase.
30	Ans: - A is series and B is in parallel, R = slope of V-I graph. Slope of I-V graph is conductance.
31	The internal resistance of a battery is influenced by temperature. On a warm day, the temperature is higher, which generally leads to lower internal resistance in the battery. Lower internal resistance allows the battery to supply a higher current. A higher current from the battery means that the starter motor receives more power. This increased power helps the starter motor to turn the engine more effectively, making it easier to start. Therefore, it is easier to start a car engine on a warm day than on a chilly day because the battery can supply more current due to lower internal resistance at higher temperatures.
32	unchanged as resistivity depends on temperature and nature of the material
33	 Resistivity of a semi conductor decreases rapidly with temperature.

34	(a) $R = \rho\, l/A$, $R \propto 1/r^2$  (b) -R = V/I and varies directly to temperature. At T_1 resistance is greater. ($T_1 > T_2$)
35	(a)The emf of a cell is greater than its terminal voltage because there is some potential drop across the cell due to its small internal resistance. (b) Q. Resistance R is inversely proportional to the area of the cross-section and directly proportional to the length. So, the resistance of the wire will be maximum when the area of cross-section is minimum and length is maximum.
36	Ans: - (a) (i) DE (slope is negative and hence resistance). (ii) BC (straight line) (b) (i) Cu (metals, alloys). (ii) Si (semiconductor).
37	(a)  (b)

Total emf of three cells in series (3ε)

= pot. Diff. corresponding to zero current

$$\therefore 3\varepsilon = 6V \text{ or } \varepsilon = \frac{6}{3} = 2V$$

The internal resistance of each cell

$$r = \frac{\varepsilon}{I_{max}} = \frac{2}{1} = 2\Omega$$

38 (a)

$$\text{As } R = \frac{\rho l}{A} \qquad \therefore A = \frac{\rho l}{R}$$

For both wires R and l are same and ρ copper < p manganin.

∴ A copper < A manganin

i.e. Manganin wire is thicker than copper wire.

(b) Manganin has a constant electrical resistance over a wide range of temperature, that is a small value of temperature coefficients. This makes it have the same resistance even if the resistor is heated up.

39 Ans: - drift velocity per unit electric field applied is termed as mobility.

(i) When the **temperature** of the **conductor decreases**, the relaxation time τ of the **electrons** in the **conductor** increases, so **mobility** μ increases.

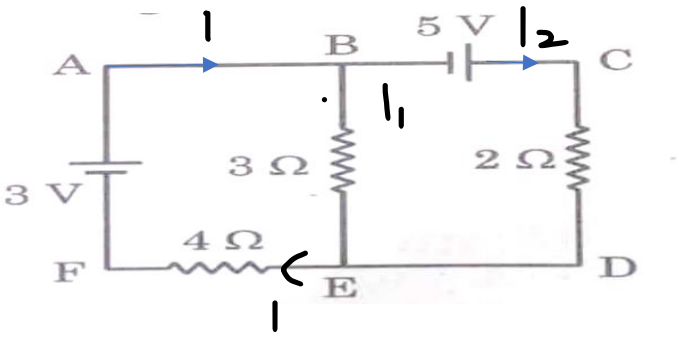
(ii) (**ii**) **Mobility** μ is independent of **applied potential difference**.

40 41. Ans: - K1L- The algebraic sum of total current into any junction of an electric circuit is zero.

$$\sum I = 0 \qquad \text{(junction rule, valid at any junction)}$$

42. K2L-The algebraic sum of the potential differences in any loop, including those associated with emfs and those of resistive elements, must equal zero.

$$\sum V = 0 \qquad \text{(loop rule, valid for any closed loop)}$$

41.	Current through the capacitor (CE) is zero, hence branch CEF is not worth in the circuit. So, equivalent resistance is 5Ω Total current is 3A. Current is CD = ½ A.
42.	(a) Electric current is considered a scalar quantity because it does not obey the laws of vector addition (such as the triangle or parallelogram laws). The arrow used in circuit diagrams does not represent a spatial vector direction; instead, it indicates the direction of flow of positive charge (conventional current) along the conductor's path. When multiple currents meet at a junction, they are added algebraically, and the result is independent of the angle between the wires. 

	Applying Kirchhoff's Junction Rule at B: $I = I_1 + I_2$ --- (1) Applying Kirchhoff's Voltage Rule (Loop Law) to loop ABEFA: $-3I_1 - 4I + 3 = 0$ $3I_1 + 4I = 3$ --- (2) Applying Kirchhoff's Voltage Rule to loop BCDEB: $-5 - 2I_2 + 3I_1 = 0$ $3I_1 - 2I_2 = 5$ --- (3) From (1), $I_2 = I - I_1$. Putting this in (3): $3I_1 - 2(I - I_1) = 5$ $3I_1 - 2I + 2I_1 = 5$ $5I_1 - 2I = 5$ $2I = 5I_1 - 5$ $I = \frac{5I_1 - 5}{2}$ --- (4) Substituting (4) in (2): $3I_1 + 4(\frac{5I_1 - 5}{2}) = 3$ $3I_1 + 2(5I_1 - 5) = 3$ $3I_1 + 10I_1 - 10 = 3$ $13I_1 = 13$ $I_1 = 1A$
43.	Equivalent resistance = 30Ω. Current = 1/15 A. Potential difference between ends of the capacitor = 1/15 x 10 = 2/3 volt. Charge on capacitor, q = CV = 2/3 x 6μ c = 4μc.
44	If galvanometer gives zero deflection, it means source of current by 12 V across R and voltage across R is 2V. Current in the circuit $I = \frac{\varepsilon}{R_1 + R_2} = \frac{12.0V}{500 + R}$ and $V = IR = 2.0V$ $\left(\frac{12.0V}{500 + R}\right)R = 2.0$ $12R = 1000 + 2R$ $10R = 1000$ $\Rightarrow R = 100\ \Omega$
45	Hints: - first remove branch BE and find the current in the circuit as 6V/ 3Ω = 2A.

	Now take a closed loop as ABEFA or BEDCA and apply the loop law to find the voltage of the capacitor and then charge.
46	In series combination of resistors, current I is given by $I = \frac{E}{R + nR'}$ whereas in parallel combination current 10 I is given by $\frac{E}{R + \frac{R}{n}} = 10I$ Now, according to problem, $\frac{1+n}{1+\frac{1}{n}} \Rightarrow 10 = \left(\frac{1+n}{n+1}\right)n \Rightarrow n = 10$
47.	$I = \frac{P}{V}$ $R = \frac{V}{I}$ Substituting the known values: Substituting the known values: $I = \frac{630\,W}{210\,V}$ $R = \frac{210\,V}{3\,A}$ Calculating the current: Calculating the resistance: $I = 3\,A$ $R = 70\,\Omega$
48.	V = E -Ir, but, V = E/2, then E/2 = E -Ir or E/2 = Ir or, I = E/2r = 1.5/2x1 = 0.75A.
49.	Hints: -equivalent resistance between B and D is 10Ω. It means 0.2 A of current is divided in to two equal parts of O.1 A. Now applying loop law for a closed path containing batteries and resistor R. -5 – (15 x 0.2) + 10 – (10 x 0.2) – 0.2 R = 0, R = 5 Ω
50.	Hints: - (i) refer to drift velocity, (ii) The electric current will remain constant. Because current is the only quantity that does not depend on the area of cross-sections of the wire.
51.	Hints: - (a) Refer to class notes. (b) Equivalent resistance of the circuit is 10 Ω. hence current is 10 A. Current across, 5 Ω is 8 A, $p = I^2R = 64 \times 5 = 320$ W.

52.	Hints: - Let I_1 be the current through the cell of 4 V. I_2 is the current through 6 V. So , the current through 8 ohms is I_1+I_2. Taking the loop of the first loop, $-4 +2 I_1+8 (I_1+I_2) +6 I_1 = 0$ $4I_1 + 2I_2 = 1$……. (i) Taking the loop of the second loop, $-6 + 4 I_2+8 (I_1+I_2) +1I_2 = 0$ $13I_2 + 8I_1 = 6$ ……. (ii) Solving both, we get, $I_1 = 1/36A$ and $I_2 = 4/9A$, Total current across 8Ω resistor = $I_1+I_2 = 17/36A$. $V = IR = 17/36 \times 8 = 34/9$ volt.
	CASE STUDY BASED QUESTIONS
53.	1. c) dimensions of material 2. a) more 3. b) less 4. d) All of the above
54.	ASSERTION REASONING QUESTIONS
1.	Answer – d
2.	Answer- d
3.	Answer – b
4.	Answer – c
5.	Answer-b
6.	Ans. A. Both Assertion and Reason are correct, and the Reason is a correct explanation of the Assertion.
7.	Ans. A. Both Assertion and Reason are correct, and the Reason is a correct explanation of the Assertion.

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