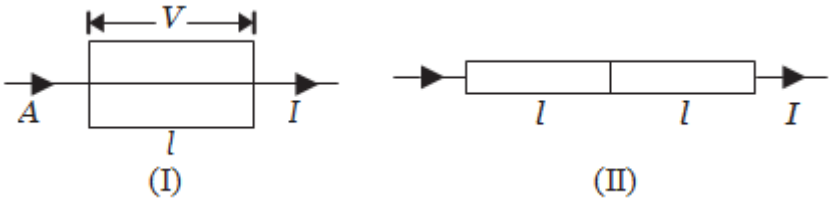
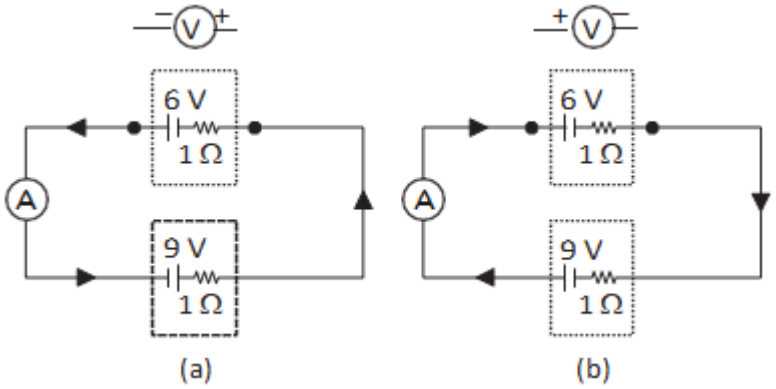
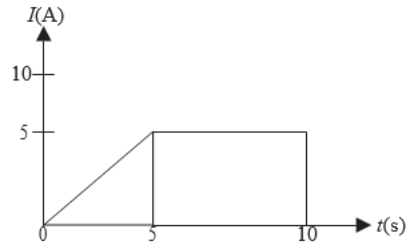
DAV PUBLIC SCHOOL THERMAL COLONY, PANIPAT

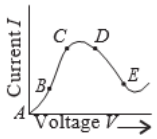
Class 12 Physics Assignment

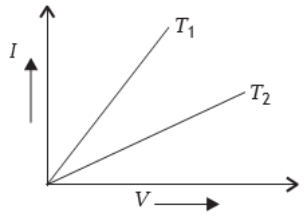
Chapter 3- CURRENT ELECTRICITY

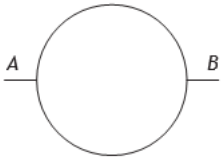
	Electric Currents in Conductors
1	How does the random motion of free electrons in a conductor get affected when a potential difference is applied across its ends ?
2	A metal rod of square cross-sectional area A having length l has current I owing through it when a potential difference of V volt is applied across its ends (figure I). Now the rod is cut parallel to its length into two identical pieces and joined as shown in figure II. What potential difference must be maintained across the length of 2l so that the current in the rod is still I?  (I) (II)
3	In the two electric circuits shown in the figure, determine the readings of ideal ammeter (A) and the ideal voltmeter (V).  (a) (b)
4	Define the term 'electrical conductivity' of a metallic wire. Write its S.I. unit.
5	Define the term drift velocity of charge carriers in a conductor and write its relationship with the current flowing through it.

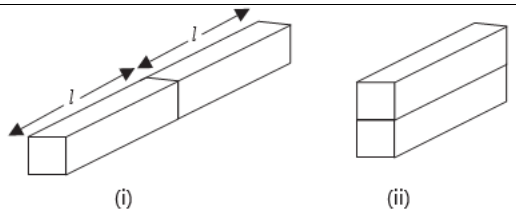
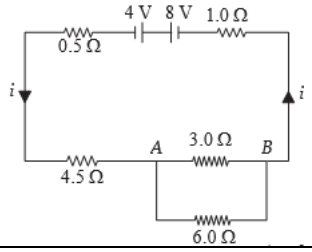
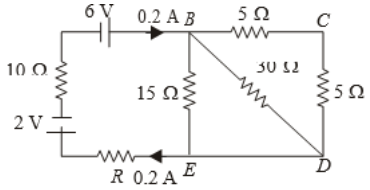
6	Write the expression for the drift velocity of charge carriers in a conductor of length '*l*' across which a potential difference '*V*' is applied.
7	When electrons drift in a metal from lower to higher potential, does it mean that all the free electrons of the metal are moving in the same direction?
8	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.
9	Using the concept of drift velocity of charge carriers in a conductor, deduce the relationship between current density and resistivity of the conductor.
10	Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area 1.0×10^{-7} m^2 carrying a current of 1.5 A. Assume the density of conduction electrons to be 9×10^{28} m^{-3}.
11	Explain the term 'drift velocity' of electrons in a conductor. Hence obtain the expression for the current through a conductor in terms of 'drift velocity'.
12	Write a relation between current and drift velocity of electrons in a conductor. Use this relation to explain how the resistance of a conductor changes with the rise in temperature.
13	Define mobility of a charge carrier. Write the relation expressing mobility in terms of relaxation time. Give its SI unit.
14	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.
15	Define drift velocity. Write its relationship with relaxation time in terms of the electric field *E* applied to a conductor. A potential difference *V* is applied to a conductor of length *l*. How

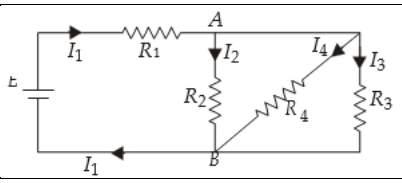
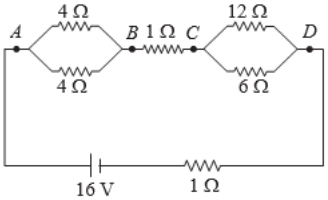
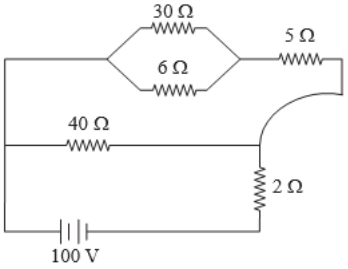
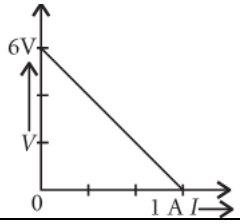
	is the drift velocity affected when V is doubled and l is halved?
16	Derive an expression for drift velocity of free electrons in a conductor in terms of relaxation time.
17	Two metallic wires of the same material have the same length but cross-sectional area is in the ratio 1 : 2. They are connected (i) in series and (ii) in parallel. Compare the drift velocities of electrons in the two wires in both the cases and (ii).
18	Derive an expression for the resistivity of a good conductor, in terms of the relaxation time of electrons.
19	(a) Find the relation between drift velocity and relaxation time of charge carriers in a conductor. (b) A conductor of length L is connected to a d.c. source of e.m.f. V. If the length of the conductor is tripled by stretching it, keeping V constant. Explain how drift velocity would be affected.
20	A steady current flow in a metallic conductor of non-uniform cross-section. Which of these quantities is constant along the conductor: current, current density, electric field, drift speed?
21	Deduce the relation between current flowing through a conductor and drift velocity v_d of the electrons. Figure shows a plot of current 'I' flowing through the cross-section of a wire versus the time 't'. Use the plot to find the charge flowing in 10 sec through the wire. 
22	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 .

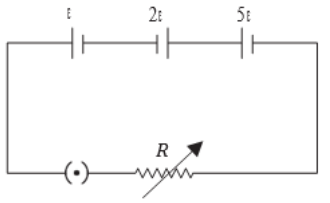
23	A conductor of length *L* is connected to a dc source of emf ε. If this conductor is replaced by another conductor of same material and same area of cross-section but of length 3*L*, how will the drift velocity change?
24	Define the term 'drift velocity' of charge carriers in a conductor. Obtain the expression for the current density in terms of relaxation time.
25	(a) Derive the relation between current density '*j*' and potential difference '*V*' across a current carrying conductor of length '*l*', area of cross- section '*A*' and the number density '*n*' of free electrons. (b) Estimate the average drift speed of conduction electrons in a copper wire of cross- sectional area 1.0×10^{-7} m^2 carrying a current of 1.5 A. [Assume that the number density of conduction electrons is 9×10^{28} m^{-3}.]
	Limitations of Ohm's Law
26	Graph showing the variation of current versus voltage for a material GaAs is shown in the figure. Identify the region of i) negative resistance ii)and where Ohm's law is obeyed. 
	Resistivity of Various Materials
27	Two wires of equal length, one of copper and the other of manganin have the same resistance. Which wire is thicker?
28	Carbon and silicon both have four valence electrons each. How then are they distinguished?

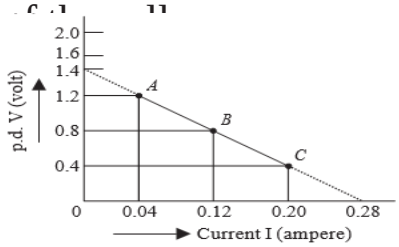
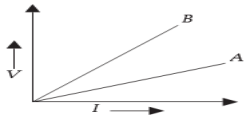
29	Define resistivity of a conductor. Write its S.I. unit.
30	(a) You are required to select a carbon resistor of resistance 47 kΩ ± 10% from a large collection. What should be the sequence of colour bands used to code it ? (b) Write the characteristics of manganin which make it suitable for making standard resistance.
31	Define ionic mobility. Write its relationship with relaxation time. How does one understand the temperature dependence of resistivity of a semiconductor?
32	The sequence of coloured bands in two carbon resistors R_1 and R_2 is (i) brown, green, blue (ii) orange, black, green Find the ratio of their resistances.
33	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.
34	A cylindrical metallic wire is stretched to increase its length by 5%. Calculate the percentage change in its resistance
35	*I-V* graph for a metallic wire at two different temperatures, T_1 and T_2 is as shown in the figure. Which of the two temperatures is lower and why? 
36	Plot a graph showing the variation of resistivity of a conductor with temperature.
37	Show variation of resistivity of copper as a function of temperature in a graph.
38	Plot a graph showing variation of current versus voltage for the

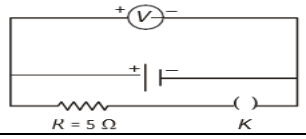
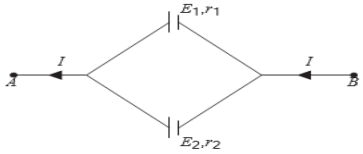
	material GaAs.
39	How does one explain increase in resistivity of a metal with increase of temperature?
40	Plot a graph showing the variation of resistance of a conducting wire as a function of its radius. Keeping the length of the wire and its temperature as constant
41	Two materials Si and Cu, are cooled from 300 K to 60 K. What will be the effect on their resistivity?
42	Show on a graph, the variation of resistivity with temperature for a typical semiconductor.
43	Draw a graph showing variation of resistivity with temperature for nichrome. Which property of nichrome is used to make standard resistance coils ?
44	Plot a graph showing temperature dependence of resistivity for a typical semiconductor. How is this behaviour explained?
45	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 semiconductor decreases with rise in temperature
	Combination of Resistors-Series and Parallel
46	A wire of resistance 8*R* is bent in the form of a circle. What is the effective resistance between the ends of a diameter *AB?* 
47	Two identical slabs, of a given metal, are joined together, in two different ways, as shown in figures (i) and (ii). What is the ratio of the resistances of these two combinations?

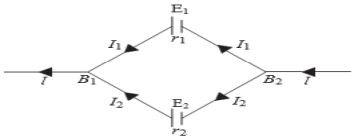
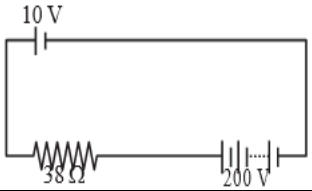
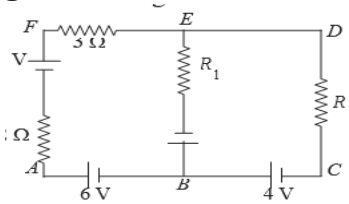
	
48	48. Given the resistances of 1 Ω, 2 Ω and 3 Ω how will you combine them to get an equivalent resistance of (i) $\frac{11}{3}$ Ω and (ii) $\frac{11}{5}$ Ω ?
49	A wire of 15 Ω resistance is gradually stretched to double its original length. It is then cut into two equal parts. These parts are then connected in parallel across a 3.0 volt battery. Find the current drawn from the battery.
50	In the circuit shown in the figure, find the current through each resistor. 
51	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 *B* and *E*? 
52	In the circuit shown, R_1 = 4 Ω, R_2 = R_3 = 15 Ω, R_4 = 30 Ω and *E* = 10 V. Calculate the equivalent resistance of the circuit and the current in each resistor.

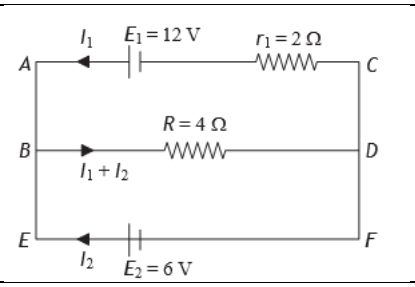
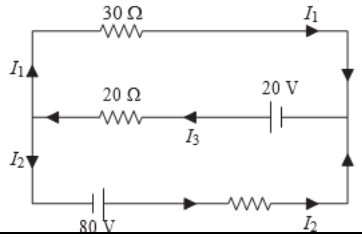
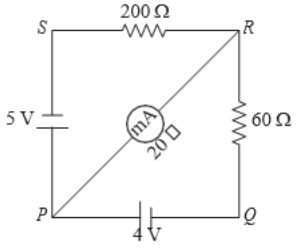
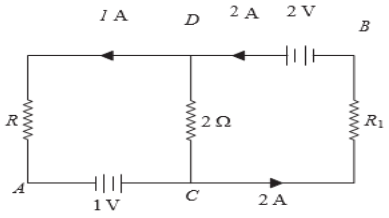
	
53	A network of resistors is connected to a 16 V battery of internal resistance of 1 Ω as shown in the figure.  a) Compute the equivalent resistance of the network b)Obtain the voltage drops V_{AB} and V_{CD}.
54	A 100 V battery is connected to the electric network as shown. If the power consumed in the 2 Ω resistor is 200 W, determine the power dissipated in the 5 Ω resistor. 
	Cells, emf, Internal Resistance
55	The plot of the variation of potential difference across a combination of three identical cells in series versus current is shown below. What is the emf and internal resistance of each cell? 
56	The emf of a cell is always greater than its terminal voltage. Why? Give reason
57	Why is the terminal voltage of a cell less than its emf?

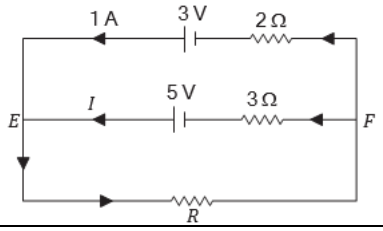
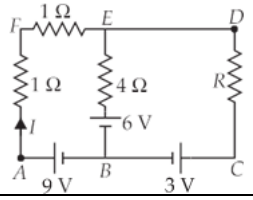
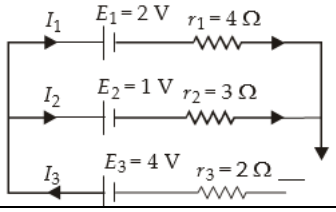
58	Three cells of emf ε, 2ε and 5ε having internal resistances r, $2r$ and $3r$ respectively are connected across a variable resistance R as shown in the figure. Find the expression for the current. Plot a graph for variation of current with R. 
59	A cell of emf 'E' and internal resistance 'r' is connected 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.
60	(a) Distinguish between emf (ε) and terminal voltage (V) of a cell having internal resistance 'r'. (b) Draw a plot showing the variation of terminal voltage (V) vs the current (I) drawn from the cell. Using this plot, how does one determine the internal resistance of the cell ?
61	A battery of emf E and internal resistance r when connected across an external resistance of 12 Ω, produces a current of 0.5 A. When connected across a resistance of 25 Ω, it produces a current of 0.25 A. Determine (i) the emf and (ii) the internal resistance of the cell.
62	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

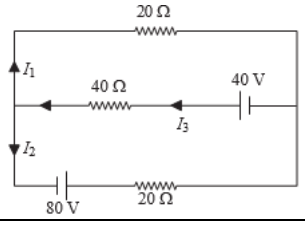
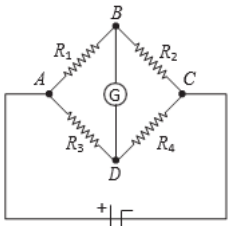
	0.42 A, 1.05 A, 1.4 A and 4.2 A, but not necessarily in that order. Identify the currents corresponding to the four cases mentioned above
63	A battery of emf 10 V and internal resistance 3 Ω is connected to a resistor. If the current in the circuit is 0.5 A, find (i) The resistance of the resistor; (ii) The terminal voltage of the battery
64	A straight line plot showing the terminal potential difference (*V*) of a cell as a function of current (*I*) drawn from it is shown in the figure. Using this plot, determine (i) the emf and (ii) internal resistance 
65	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*' .
66	*V-I* graphs for parallel and series combination of two metallic resistors are shown below. Which graph represents parallel combination? 
67	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 *R* and (ii) the current *I*. It is found that when *R* = 4 Ω, the current is 1 A and when *R* is increased to 9 Ω, the current reduces to 0.5 A. Find the values of the emf *E* and internal resistance *r*.

68	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 V. When the terminals of the cell are also connected to a resistance of 5 Ω as shown in the circuit, the voltmeter reading drops to 1.8 V. Find the internal resistance of the cell. 
69	A cell, with a finite internal resistance r, is connected across two external resistances R_1 and R_2 ($R_1 > R_2$), one by one. In which case would the terminal potential difference of the cell be more ?
	Cells in Series and in Parallel
70	Two identical cells, each of emf E, having negligible internal resistance, are connected in parallel with each other across an external resistance R. What is the current through this resistance?
71	Two cells, of emf 2ε and ε, and internal resistance $2r$ and r respectively, are connected in parallel. Obtain the expression for the equivalent emf and the internal resistance of the combination.
72	Two cells of emfs 1.5 V and 2.0 V having internal resistances 0.2 Ω and 0.3 Ω respectively are connected in parallel. Calculate the emf and internal resistance of the equivalent cell.
73	Two cells of emf E_1, E_2 and internal resistance r_1 and r_2 respectively are connected in parallel as shown in the figure  Deduct the expression for (i) The equivalent emf of the combination (ii) The equivalent resistance of the combination

	(iii) The potential difference between the points A and B.
74	Two cells of emfs E_1 and E_2 and internal resistance r_1 and r_2 are connected in parallel. Obtain the expression for the emf and internal resistance of a single equivalent cell that can replace this combination?
75	Two cells of emf ε_1 and ε_2 having internal resistances r_1 and r_2 respectively are connected in parallel as shown. Deduce the expressions of the equivalent emf a cell which can replace the combination between the points B_1 and B_2. 
	Kirchhoff's Laws
76	A 10 V battery of negligible internal resistance is connected across a 200 V battery and a resistance of 38 Ω as shown in the figure. Find the value of the current in circuit. 
77	Use Kirchhoff's rules to determine the potential difference between the points A and D when no current flows in the BE of the electric network shown in the figure. 
78	State Kirchhoff's rules. Explains briefly how these rules are justified.
79	In the electric network shown in the figure, use Kirchhoff's rules to calculate the power consumed by the resistance $R = 4\ \Omega$.

	
80	An ammeter of resistance 0.80 Ω can measure current up to 1.0 A. (i) What must be the value of shunt resistance to enable the ammeter to measure current up to 5.0 A? (ii) What is the combined resistance of the ammeter and the shunt?
81	Use Kirchhoff's rules to determine the value of the current I_1 flowing in the circuit shown in the figure 
82	The network *PQRS*, shown in the circuit diagram, has the batteries of 4 V and 5 V and negligible internal resistance. A milliammeter of 20 Ω resistance is connected between *P* and *R*. Calculate the reading in the milliammeter. 
83	In the given circuit, assuming point *A* to be at zero potential, use Kirchhoff's rules to determine the potential at point *B*. 

84	Using Kirchhoff's rules in the given circuit, determine (i) the voltage drop across the unknown resistor *R* and (ii) the current *I* in the arm *EF*. 
85	Using Kirchhoff's rules determine the value of unknown resistance *R* in the circuit so that no current flows through 4Ω resistance. Also find the potential difference between *A* and *D*. 
86	(a) State Kirchhoff's rules. (b) Use these rules to write the expressions for the currents I_1, I_2 and I_3 in the circuit diagram shown. 
87	(a) State Kirchhoff's rules. (b) A battery of 10 V and negligible internal resistance is connected across the diagonally opposite corners of a cubical network consisting of 12 resistors each of 1 Ω resistance. Use Kirchhoff's rules to determine (i) the equivalent resistance of the network, and (ii) the total current in the network.
88	(a) State Kirchhoff's rules of current distribution in an electrical

	network. (b) Using these rules determine the value of the current I_1 in the electric circuit given below 
89	The given figure shows a network of resistances R1, R2, R3 and R4. Using Kirchhoff's laws, establish the balance condition for the network 
90	Use Kirchhoff's rules to obtain conditions forthe balance condition in a Wheatstone bridge.