1. Plot a graph showing the variation of resistivity of a conductor with temperature.
2. Define electrical conductivity of a conductor and give its SI unit.
3. Explain why resistance becomes more in series combination?
4. Why do we prefer a potentiometer to measure emf of a cell rather than a voltmeter?
5. Define the term drift velocity.
6. State Ohm's law.
7. Can Kirchhoff's laws be applied to both d.c. and a.c. circuits ?
8. On what conservation principle is the Kirchoff's first law based ?
9. What is the resistance of an ideal ammeter ?
10. Define the term 'mobility' of charge carriers. Write the SI unit.

11. Write the expression for the torque $\vec{\tau}$ acting on a dipole of dipole moment $\vec{p}$ placed in an electric field $\vec{E}$.
12. What is the cause of charging?
13. What does $q_1 + q_2 = 0$ signify in electrostatics ?

OR

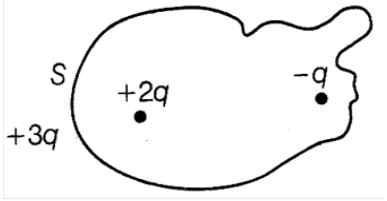
Two charges $q_1 + q_2$, separated by a small distance satisfy the equation $q_1 + q_2 = 0$. What does it tell about the charges ?

14. How many electrons are present in 1 coulomb of charge ?
15. Define electric dipole moment. Write its SI unit.
16. Why do the electrostatic field lines not form closed loops ?
17. Define electric dipole moment and write its SI unit.
18. Make the graph for electric potential with distance.
19. Define the term electric dipole moment. Is it a scalar or vector? Deduce an expression for the electric field at a point on the equatorial plane of an electric dipole of length 2 *a*.
20. Make the graph between inductor reactance and frequency.
21. (i) Write the S.I. unit of (i) Electric field Intensity and (ii) electric dippole moment.
22. (i) State the coulumb's law of force in electrostatics.

(ii) Define relative Di-electric constant and write its dimensional formula.

23. What is the electric flux through a cube of side 1 cm which encloses an electric dipole?

24. Figure shows three point charges, + 2q, - q and +3q. Two charges +2q and - q are enclosed within a surface S. What is the electric flux due to this configuration through the surface S?



25. Relative permeability of a material $\mu_r = 0.5$. Identify the nature of the magnetic material and write its relation of magnetic susceptibility.

26. Where on the surface of earth is the angle of dip 90^o?

27. The permeability of a magnetic material is 0.9983. Name the type of magnetic material, it represents.

28. Show diagrammatically the behaviour of magnetic field lines in the presence of

(i) paramagnetic and

(ii) diamagnetic substances. How does one explain this distinguishing feature?

29. Out of the two magnetic materials, A has relative permeability slightly greater than unity while B has less than unity. Identify the nature of the materials A and B. Will their susceptibilities be positive or negative?

30. How is an electromagnet different from a permanent magnet?

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

32. How can the sensitivity of potentiometer be increased?

33. V-I graphs for parallel and series combination of two metallic resistors are as shown in figure. Which graph represents parallel combination? Justify your answer.

34. Two wires of equal cross-sectional area, one of copper and other of manganin have the same resisance. Which one will be longer?

35. 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 than in Y, find the ratio of drift velocity of electrons in the two wires.

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

(b) Write the characteristics of manganin which make it suitable for making standard resistance.

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

38. Given the resistance of 1Ω, 2Ω and 3Ω. How will you combine them to get an equivalent resistance of (*i*) $\frac{11}{3}\Omega$ and (*ii*) $\frac{11}{5}\Omega$?

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

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

Or

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 $8\times10^{28}m^{-3}$, calculate the resistivity of the material of wire.

41. State Gauss therorem in electrostatics. Apply this theorem write the expression for the electric field at a point due to an infinity long, thin, uniformly charged straight wire linear charge density λ C m^{-1}.

42. Two charges q_1 and q_2 placed at a separation *d* in air experience a force of 12 N. If the separation is changed to *d*', the force becomes 3 N. What is the value of *d*' in terms of *d*'?

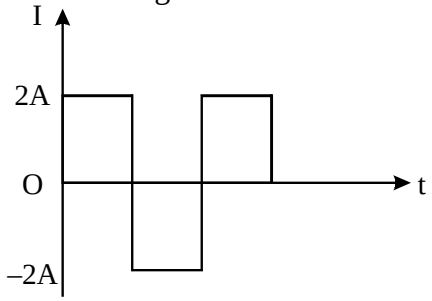
43. Derive the relation between electric potential and electric field intensity.

44. Derive an expression for the electric potential due to an electric dipole.

45. Briefly explain how does a comb run through dry hair attract small pieces of paper.

46. The electric mains in a house are marked 220 V, 50 Hz. Write down the equation for instantaneous voltage.

47. Calculate the rms value of the alternating current shown in figure.



48. The instantaneous emf of an a.c. source is given by $\xi = 300\sin 314t$. What is the rms value of the emf?

49. Find the maximum value of current when an inductance of one henryg is connected to an a.c. source of 200 volts, 50 Hz.

50. A coil has an inductance of 1 H. (i) At what frequency will it have a reactance of 3142 Ω? (ii) What should be the capacity of a capacitor which has the same reactance at that frequency?

51. In which orientation, a dipole placed in a uniform electric field is in (*i*) stable, (*ii*) unstable equilibrium?

52. What is the work done in moving a test charge *q* through a distance of 1 cm along the equtorial axis of an electric dipole ?

53. Can you say that the earth is an equipotential surface ?

54. How much work is done in moving a 500 μC charge between two points on an equipotential surface?

55. Why must electrostatic field be normal to the surface at every point of a charged conductor?

56. Why should electrostatic field be zero inside a conductor?

57. Why is electrostatic potential constant throughout the volume of the conductor and has the same value (as inside) on its surface ?

58. Define dielectric constant in terms of the capacitance of a capacitor.

59. Why do ordinary capacitors have capacities of the order of microfarads?

60. A metal plate is introduced between the plates of a charged parallel plate capacitor. What is the effect on the capacitance of the capacitor ?

61. Using Biot-Savart's law, deduce the expression for the magnetic field produced at the centre of a semi-circular wire loop of radius R, carrying a current. *I*.

62. 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.

63. Two identical circular loops, *P* and Q, each of radius *r* and carrying equal currents are kept in the parallel planes having a common axis passing through *O*. The direction of current in *P* is clockwise and in *Q* is anticlockwise as seen from *O* which is equidistant from the loops *P* and *Q*. Find the magnitude of net magnetic field at *O*.

65. An *a*-particle and a proton moving with the same speed enter the same speed enter the same magnetic field region at right angles to the direction of the field. Show the trajectories followed by the two particles in the region of the magnetic field. Find the ratio of the radii of the circular paths which the two particles may describe.

66. State Biot-Savart law, giving the mathematical expression for it.

    Use this law to derive the expression for the magnetic field due to a circular coil carrying current at a point along its axis.

    How does a circular loop carrying current behave as a magnet ?

67. Derive and expression for the magnetic field along the axis of an air-cored solenoid, using Ampere's circuital law. Sketch the magnetic field lines for a finite solenoid. Explain why the field at the exterior midpoint is weak while at the interior it is uniform and strong.

68. Draw a schematic diagram of a cyclotron. Explain its underlying principle and working, stating clearly the function of the electric and magnetic fields applied on a charged particle.

    Deduce an expression for the period of revolution and show that it does not depend on the speed of the charged particle.

69. Prove that for an inductor current lags by $\frac{\pi}{2}$ and for a capacitor current leads by $\frac{\pi}{2}$.

70. Draw a phasor diagram for LCR series circuit. Find impedance in the circuit along with phase difference between voltage and current.

71. Write the differential equation for a LRC circuit. What is the order of the equation.

72. A resistor of 200 Ω and a capacitor of 15.0 μF are connected in series to a 220 V, 50 Hz ac source. (a) Calculate the current in the circuit; (b) Calculate the voltage (rms) across the resistor and the capacitor. Is the algebraic sum of these voltages more than the source voltage? If yes, resolve the paradox.

73. Define :

Resonance, Sharpness, Bandwidth, Power factor.

74. Find expressions for charge and current in LC oscillations. Why is LC oscillation practically not realistic, explain?

75. Show that in the free oscillations of an LC circuit, the sum of energies stores in the capacitor and the inductor is constant in time.

76. Draw neat diagram of transformer. Explain stepup and step down transformer with its principle.

77. What are the types of energy losses in the transformer and how can they be minimised.

78. A series *LCR* circuit with $R = 20\ \Omega$, $L = 1.5$ H and $C = 35\ \mu$F is connected to a variable-frequency 200 V ac suply. When the frequency of the supply equals the natural frequency of the circuit what is the average power transferred to the circuit in one complete cycle?

79. A coil of inductance 0.50 H and resistance 100 Ω is connected to a 240 V, 50 Hz ac supply.

    (a) What is the maximum current in the coil?

    (b) What is the time lag between the voltage maximum and the current maximum?

80. A 100 μF capacitor in series with a 40 Ω resistance is connected to a 110 V, 60 Hz supply.

    (a) What is the maximum current in the circuit?

    (b) What is the time lag between the current maximum and the voltage maximum?

81. Obtain the resonant frequency ω of a series *LCR* circuit with $L = 2.0$H, $C = 32\ \mu$F and $R = 10\ \Omega$ What is the *Q*-value of this circuit?

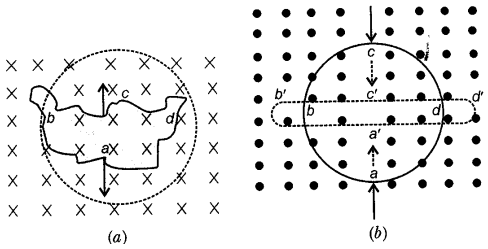
82. A 44 mH inductor is connected to 220 V, 50 Hz ac supply. Determine the rms value of the current in the circuit.

83. Keeping the source frequency equal to the resonating frequency of the series *LCR* circuit, if the three elements, *L*, *C* and *R* are arranged in parallel, show that the total current in the parallel *LCR* circuit is minimum at this frequency.

84. Use Lenz's law to determine the direction of induced current in the situations described by given figure.

    (a) A wire of irregular shape turning into a circular shape;

    (b) A circular loop being deformed into a narrow straight wire.



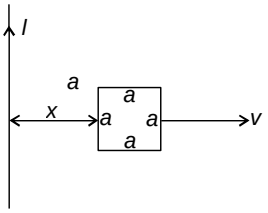
85. A long solenoid with 15 turns per cm has a small loop of area 2.0 cm^2 placed inside the solenoid normal to its axis. If the current carried by the solenoid changes steadily from 2.0 A to 4.0 A in 0.1 s, what is the induced emf in the loop while the current is changing ?

86. A jet plane is travelling towards west at the speed of 1800 km/h. What is the voltage difference developed between the ends of the wing having a span of 25 m, if the earth's magnetic field at the location has a magnitude of 5×10^{-4} T and the dip angle is 30°.

87. A square loop of side 12 cm with its sides parallel to X and Y axes is moved with a velocity of 8 cm s^{-1} in the positive *x*-direction in an environment containing a magnetic field in the positive *z*-direction. The field is neither uniform in space nor constant in time. It has a gradient of 10^{-3} T cm^{-1} along the negative *x*-direction (that is it increases by 10^{-3} T cm^{-1} as one moves in the negative *x*-direction), and it is decreasing in time at the rate of 10^{-3} T s^{-1}. Determine the direction and magnitude of the induced current in the loop if its resistance is 4.50 mΩ.

88. (a) Obtain an expression for the mutual inductance between a long straight wire and a square loop of side *a* as shown in figure.

(b) Now assume that the straight wire carries a current of 50 A and the loop is moved to the right with a constnat velocity, $v = 10$ ms^{-1}. Calculate the induced emf in the loop at the instant when $x = 0.2$ m. Take $a = 0.1$ m and assume that the loop has a large resistance.



89. A rectangular conductor LMNU is placed in a uniform magnetic field $\vec{B}$ directed perpendicular to the plane of paper. Obtain the expression for emf when conductor is moving from right to left.

90. Use Lenz's law to determine the direction of the induced current when a rectangular conducting loop *abcd* is moved into a region of magnetic field which is directed normal to the plane of the loop away from the reader.

91. A thin conducting spherical shell of radius R and charge Q spread uniformly over its surface. Using Gauss's law derive and expression for an electric field at a point outside the shell. Draw a graph of electric field E(r) with distance R from the centre of the shell for $0 \leq r \leq \infty$.

92. (a) Derive an expression for the electric potential and electric field at the axis of a dipole.

(b) Use Gauss theorem to show that the electric field strength near an infinity charged sheet is independent of diatance of point from the sheet. What is the value of electric field Strength.

93. Explain the underlying principle of warking of a parallel plate capacitor. If two similar plates, each of area A having surface charge densities $+\sigma$ and $-\sigma$ are separated by a distance d in air, write expressions for

i) The electric field at pints between the two plates.

ii) the potenteial difference between the plates.

iii) the capacitance of the capacitor so formed

94. (a) Describe consturection and principle of potentiometer, How can you

(i) compare emf of two cells

(ii) internal resistance of a cell with its help?

(b) Explain how does the conductivity of a (i) metalic conductor (ii) semiconductor and

(iii) insulator varies with the rise of temperature.

95. State Ampere's circuital law. Use it to find an expression for magnetic field due to (i) a long solenoid (ii) a toroid.

96. Derive and expression for torque on a current carrying rectangular loop. When is this torque maximum?

97. What are dia, para and ferromagnetic substances? Give at least four points of distinction of these substances.

98. What is the effect of temperature on diamagnetic, paramagnetic and ferromagnetic substances? Explain.

99. Name three elements required to specify the earth's magnetic field at a given place. Draw a labelled diagram to define these elements. Explain brieflyhow these elements are determined to find out the magnetic field at a given place on the surface of the earth.

100. A metallic rod of length 'l' is rotated with a frequency v with one end hinged at the centre and the other end at the circumference of a circular metalic ring of radius r, about an axis passing through the centre and perpendicular to the plane of the rinig. A constant uniform magnetic field B parallel to the axis is present every where. using Lorentz force, explain how emf is induced between the centre and the metallic ring and hence obtain the expression for it.