CHAPTER 1(ELECTRIC CHARGES & FIELDS)

1. Why do the electric field lines never cross each other?
2. Define electric dipole moment. Is it a scalar or vector? Derive the expression for the electric field of a dipole at a point (i) on the equatorial plane of the dipole.
(ii) on the axis of the dipole.
3. Using Gauss's law deduce the expression for the electric field due to an uniformly charged spherical conducting shell of radius R at a point (i) outside (ii) inside the shell. Plot a graph showing the variation of electric field as a function of r>R and r<R. ('r' being the distance from the centre of the shell)
4. An electric dipole is held in a uniform electric field. (i) Show that net force acting on it is zero. (ii) Find the torque acting on a dipole and specify its direction (iii) If the dipole is aligned parallel to the field, find the work done in rotating through the angle of 1800.
5. Why do the electrostatic field lines not form closed loops?
6. If coulomb's law had 1/r3 dependence instead of 1/r2, would Gauss's theorem had been still valid?
7. Use Gauss' law to find the electric field due to a uniformly charged infinite plane sheet. What is the direction of field for positive and negative charge densities?
8. (i) If two similar large plates, each of area A having surface charge densities + and – are separated by a distance d in air, find the expressions for
(a) Field at point between the two plates and on outer side of the plates. Specify the direction of the field in each case.
(b) The potential difference between the plates.
(c) The capacitance of the capacitor so formed.
(ii) Two metallic spheres of radii R and 2R are charged so that both of these have same surface charge density . If they are connected to each other with a conducting wire, in which direction will the charge flow and why?
9. If the total charge enclosed by a surface is zero, does it imply that the electric field everywhere on the surface is zero? Conversely, if the electric field everywhere on a surface is zero, does it imply that net charge inside it is zero?
10. (a) Derive an expression for the electric field E due to a dipole of length '2a' at a point distant r from the centre of the dipole on the axial line. (b) Draw a graph of E versus r for r>>a. (c) If this dipole were kept in a uniform external field E0, diagrammatically represent the position of the dipole in stable and unstable equilibrium and write the expression for torque acting on the dipole in both cases.
11. (a) Use Gauss' law to derive the expression for the electric field due to a straight uniformly charged infinite line of charge density λ C/m. (b)Draw a graph to show the variation of E with perpendicular distance r from the line of charge.

12. Show that the force on each plate of a parallel plate capacitor has a magnitude equal to ½ QE, where Q is the charge on the capacitor and E is the magnitude of electric field between the plates. Explain the origin of the factor ½.
13. A slab of material of dielectric constant K has the same area as that of the plates of a parallel plate capacitor but has the thickness d/3, where d is the separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of the capacitor.
14. Describe schematically the equipotential surface corresponding to a constant electric field in z direction.
15. Derive an expression for the energy stored in a parallel plate capacitor C, charged to a potential difference V. Hence derive an expression for the energy density of a capacitor.
16. A parallel plate capacitor is charged by a battery, which is then disconnected. A dielectric slab is then inserted in the space between the plates. Explain what changes if any occur in the values of :
(i)capacitance (ii) potential difference between the plates (iii) electric field between the plates and (iv)energy stored in the capacitor.
17. Prove that a closed equipotential surface with no charge within itself must enclose an equipotential volume.
18. Two charges q1 and q2 are placed at (0, 0, d) and (0, 0, –d) respectively. Find locus of points where the potential is zero.
19. Two identical parallel plate capacitors A and B are connected to a battery of V volts with the switch S is closed. The switch is now opened and the free space between the plates of the capacitor is filled with a dielectric of dielectric constant K. Find the ratio of total energy stored in both capacitors before and after the introduction of the dielectric.
20. Do free electrons travel to a region of higher to lower potential?

QUESTION BANK

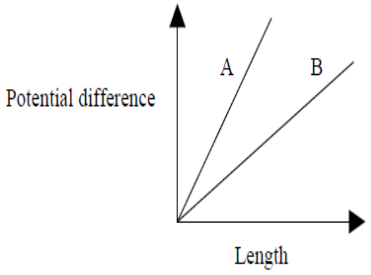
CURRENT ELECRICITY

1. Why manganin is used for making standard resistor?
2. The sequence of bands marked on a carbon resistor are: Red, Red, Red, Silver. Write the value of resistance with tolerance.
3. A wire of resistivity ρ is stretched to three times its initial length, what will be its new resistivity.
4. If p.d.v applied across a conductor is increased to 2v, how will the draft velocity of the electrons change?
5. A 10Ω thick wire is stretched so that its length becomes three times. Assuming that there is no change in its density on stretching. Calculate the resistance of new wire.
6. Give any two applications super conductors.

7. Two wire of equal length one copper and manganin have same resistance , which wire is thicker?.
8. A copper wire of resistivity r is stretched to reduce its diameter to half of its previous value .What will be the new resistances?

OR

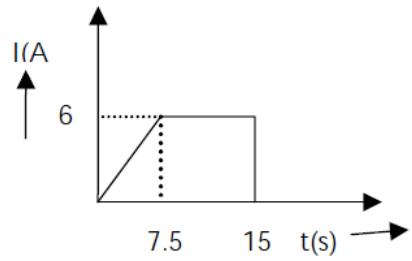
A wire of resistance 4R is bend in the form of circle .What is the effective resistance between the ends of diameter?.
9. You are given 8 Ω resistor. What length of wire of resistance 120 Ωm-1 should be joined in parallel with it to get a value of 6 Ω ?
10. Three resistance 3Ω,6Ω and 9Ω are connected to a battery. In which of them will the power dissipation be maximum if
a) They all are connected in parallel
b) They all are connected in series Give reason.
11. A silver wire has a resistance of 2.1Ω at 27.5˚c and a resistance of 2.7Ω at 100˚c. Determine the temperature coeff. of resistivity of silver.
12. The variation of potential difference with length in case of two potentiometres A and B is given below.Which of the two is more sensitive.



13. If the length of the wire conductor is doubled by stretching it , keeping potential difference constant by what factor the drift speed of the electron changes.
14. Two 120V light bulbs , one of 25W and another of 200W are connected in series . One bulb burnt out almost instantaneously ?.Which one was burnt and why?.
15. A cylindrical metallic wire is stretched to increase its length by 5% . Calculate the Percentage change in resistances.
16. A wire of resistance 4R is bend in the form of circle .What is the effective resistance between the ends of diameter?.
17. Two wires A and B have same lengths and same material, have their cross sectional areas 1:4 , what would be the ratio of heat produced in these wires when the voltage across each is constant.
18. Two bulbs whose resistance are in the ratio of 1:2 are connected in parallel to a source of constant voltage. What will be the ratio of power dissipation in these?

OR

Plot of current I versus time interval is given below. Find the charge that flows through the wire



during this time period

19. A student has two wire of iron and copper of equal length and diameter.He first joins two wires in series and pass electric current through the combination which increases gradually.After that he joins two wires in parallel and repeats the process of passing current.Which wire will glow first in each case?

20. Total resistance of the circuit is R/3 in which three identical resistors are connected in parallel. Find the value of each resistance?.

21. Amount of charge passing through the cross section of a wire is $q(t)=at^2+bt+c$.Write the dimensional formula for a, b and c. If the values of a, b and c in SI unit are 6, 4, 2 respectively. Find the value of current at t=6 seconds.

22. Prove that current density of a matellic conductor is directly-proportional to the speed of electrons.

23. Name the carriers of electric current in

1) a bar made of silver
2) hydrogen discharge tube
3) a germanium semiconductor
4) a wire made of alloy nichrome
5) supper conductor.
6) salt water

24. a potential difference V is applied across the ends of length I and diameter D .what is the effect on drift velocity of electrons if

a) V is doubled
b) I is doubled
c)D is doubled

25. Draw a graph showing variation of resistivity with temperature for

a) nichrome
b)silicon

26. A uniform wire of resistance “R” is shaped into a regular “n” sided polygon, where “n” is even. Find the equivalent resistance between

1) opposite corners of the polygon
2) adjacent corners of the polygon.

27. Under what condition is the heat produced in an electric circuit

1) directly proportional
2) inversely proportional to the resistance of the circuit?

28. state the working principle of potentiometer explain with the help of circuit diagram how the emf of two primary cells are compared by using the potentiometer

29. State Kirchhoff's law an electrical network. Using the Kirchhoff's laws deduce the condition for balance in the Wheat-stone bridge.
30.State the working principle of potentiometer explain with the help of circuit diagram how the potentiometer is used to determine the internal resistance of the given primary cell.

One mark questions

1.One alpha particle and a deuteron entered perpendicularly in a uniform magnetic field with same velocity. Which one follow the greater circle?
2 Out of Voltmeter and Mille voltmeter, which has the higher resistance?
3. Proton is moving along the axis of a solenoid carrying current of 2 A and 50 number of turns per unit length. What will be the force acting on the particle.
4. Out of Ammeter and Mille ammeter, which has the higher resistance?
5. The pole of a magnet is brought near to a stationary charge. What will be the force experienced by pole?
6. Current 'I' flows along the length of an infinitely long straight thin walled pipe. What is the magnetic field at any point on the axis of pipe?
7. The Earth's core contains iron but geologists do not regard this as a source of Magnetic Field, Why?
8. A Magnetic Field dipole placed in a Magnetic Field experiences a net force. What can you say about the Nature of Magnetic Field?

Two marks questions

9. Suppose a helical spring is suspended from the roof of a room and very small weight is attached to its lower end what will happen to the spring when a current is passed through it? Give reason to support your answer?
10. Can a Moving Coil Galvanometer can be used to detect an A.C. in a circuit .Give reason.
11. Two wires of equal length are bent in the form of two loops. One loop is square whereas the other is circular. These are suspended in same magnetic field and same current is passed through them. Explain with reason which will experience greater torque?
12. A charge particle moving in a magnetic field penetrates a layer of lead and thereby losses half of its kinetic energy. How does the radius of curvature of its path change?
13. Earth's Magnetic Field does not affect working of moving Coil Galvanometer. Why?
14. A proton is about 1840 times heavier than an electron. What will be its kinetic energy when it is accelerated by a potential difference of 1KV?
15 What is the work done by a magnetic field on moving a charge? Give reason
16 Why does the kinetic energy of the charge not change while moving in the magnetic field.
17 If B is the magnetic field produced at the centre of a circular coil of one turn of length L carrying current I then what is the magnetic field at the centre of the same coil which is made into 10 turns?
18. Find the magnetic moment of a wire of length l carrying current I bent in the form of a circle.

Three mark questions

19. A Voltmeter, an ammeter and a resistance are connected in series with a battery. There is some deflection in voltmeter but the deflection of ammeter is zero. Explain why?
How does a ferromagnetic material change its Magnetic properties if it is heated beyond its curie temperature?
20. Two long straight wires are set parallel to each other. Each carries a current I in the same direction and the separation between them is 2r. What is the intensity of the magnetic field

mid way between them?
21. A circular loop of radius R carrying current I ,lies in X-Y plane with its centre at origin.What is the total magnetic flux through X-Y plane?
22. A circular current carrying coil has a radius R. What is the distance from the centre of the coil on its axis where the magnetic field is 1/8 th of its value at the centre?
23. A magnetic needle suspended freely in a uniform magnetic field experiences torque but no net force. A nail made up of iron kept near a bar magnet experience a force of attraction and torque .Give reason.
24.A particle with charge q moving with velocity v in the plane of the paper enters a uniform magnetic field B acting perpendicular to the plane of the paper. Deduce an expression for the time period of the charge as it moves in a circular path in the field .
25. What is the magnetic field produced at the centre of curvature of an arc of wire of radius r carrying current I subtends an angle P /2radians at its centre.
26. When current is flowing through two parallel conductors in the same direction they attract while two beams of electrons moving in the same direction repel each other. Why?
27. Draw diagrams to show behavior of magnetic field lines near a bar of (i) Alluminium (ii) copper and (iii) mercury cooled to a very low temperature 4.2 K

Five mark questions

28, a) An electron travelling west to east enters a chamber having a uniform electrostatic field in north to south direction.Specify the direction in which the uniform magnetic field should be set up to prevent the electron from deflecting from its straight line path.
b) A straight horizontal conducting rod of length 0.5 m and mass 50 g is suspended by two vertical wires at its ends.A current of 5A is set up in the rods through the wires.(i) What magnetic field should be set up normal to the conductor in order that the tension in the wires is zero?(ii)What will be the tension in the wire if the direction of current is reversed keeping the magnetic field same as before?(neglect the mass ; $g=10m/s^2$)
29. Draw a neat and labelled diagram of a cyclotron . State the underlying the principle and explain how a positively charged particle will get accelerated. Show mathematically the cyclotron frequency does not depend upon speed of the particle.
30. With the help of a labelled diagram the underlying principle and working of a moving coil galvanometer. What is the function of
i) uniform radial field
ii) soft iron core in such a device.