Convent of Jesus and Mary, New Delhi
Class XII-PHYSICS
Holiday Assignment

Chapter: Electric charges and Fields

One Mark Questions

1. A 500 micro-coulomb charge is at the centre of a square of side 10 cm. Find the work done in moving a charge of 10 micro-coulomb between two diagonally opposite points on the square.
2. Why should electrostatic field be zero inside a conductor?
3. What is the geometrical shape of equipotential surfaces due to a single isolated charge?
4. Why do the electric field lines never cross each other?

Two Mark Questions:

5. Derive an expression for the electric field at a point on the axial position of an electric dipole.
6. Derive an expression for the electric field at a point on the equatorial position of an electric dipole.
7. Force between two points electric charges kept at a distance d apart in air is F.If these charges are kept at the same distance in water, how does the force between them gets effected ?
8. Two point charges 10μC and 20μC are separated by a distance r in air. If an additional charge of -8μC is given to each, by what factor does the force between the charges change?
9. Calculate the Coulomb force between a proton and an electron separated by a distance of 0.8×10^{-15}m.

Three Mark Questions

10. Using Gauss's law to obtain the expression for the electric field due to a uniformly charged thin spherical shell of radius R at a point outside the shell. Draw a graph showing the variation of electric field with r, for r > R and r< R.

11. A positive point charge (+q) is kept in the vicinity of an uncharged conducting plate. Sketch electric filed lines originating from the point on the surface of the plate. Derive the expression for the electric field at the surface of a charged conductor.

12. Two point electric charges of values q and 2q are kept at a distance d apart from each other in air. A third charge Q is to be kept along the same line in such a way that the net force on q and 2q is zero. Calculate the position of the charge Q in terms of q and d.
13. Force of attraction between two point charges placed at a distance 'd' apart in a medium is 'F'. What should be the distance in the same medium so that the force between them becomes 9F?

14. Two similarly and equally charged identical metal spheres A and B repel each other with a force of $2x10^{-5}$ N. A third identical uncharged sphere C is touched with A and then placed at the midpoint between A and B. Calculate the net electric force on C.
15. Ram and Shyam went to the trade fair. They were by side of a crowded corner, where Balloons were sold. A child was seen troubling his parent and crying for something. On seeing this, Ram went to the child and said that he would perform a trick with balloons. Ram took two balloons and Shyam helped him to inflate and tie. When the balloons were rubbed with the sweater he was wearing, they were attracted. When taken nearer to wall, the balloons got stuck. The child enjoyed and stopped crying.
How did the balloons get attracted? Will they repel also?

Five Mark Questions

16. (a) Using Gauss' law, derive an expression for the electric field intensity at any point outside a uniformly charged thin spherical shell of radius R and charge density σ C/m^2.Draw the field lines when the charge density of the sphere is
    (I) positive,
    (II) negative.

    (b) A uniformly charged conducting sphere of 2.5 m in diameter has a surface charge density of 100μC/m^2. Calculate the

    (i) Charge on the sphere

    (ii) Total electric flux passing through the sphere.

17. Deduce the expression for the torque acting on a dipole of dipole moment **P** in the presence of a uniform electric field
    (b) Consider two hollow concentric spheres S1 and S2, enclosing charges 2Q and 4Q.
    (i) Find out the ratio of the electric flux through them.
    (ii) How will the electric flux through the sphere s1 change if a medium of dielectric constant 'Ɛr' is introduced in the space inside s1 in place of air? Deduce the necessary expression.
18. State Gauss theorem and apply it to find the electric field at a point due to
    (a) a line of charge
    (b) A plane sheet of charge
    (c) A Charged spherical conducting shell

Chapter: ELECTROSTATIC POTENTIAL AND CAPACITANCE

One Mark Questions

1. Define the term 'dielectric constant' of a medium in terms of capacitance of a capacitor.
2. In which orientation, a dipole placed in a uniform electric field is in
   (i) stable, (ii)unstable equilibrium?

3. What is the geometrical shape of equi-potential surfaces due to a single isolated charge?
4. Net capacitance of three identical capacitors connected in parallel is 12 microfarad. What will be the net capacitance when two of them are connected in (i) parallel (ii) series ?
5. If an electron is accelerated by a Potential difference of 1 Volt, Calculate the gain in energy in Joule and electron volt.

Two Mark Questions

1. Draw a plot showing the variation of (i) electric field and (ii) electric potential V with distance r due to a point charge Q.
2. A parallel plate capacitor of capacitance C is charged to a potential V. It is then connected to another uncharged capacitor having the same capacitance. Find out the ratio of the energy stored in the combined system to that stored initially in the single capacitor.
3. Derive an expression for the effective capacitance when capacitors are connected in (a) series and (b) parallel
4. Explain the principle of a capacitor and derive an expression for the capacitance of a parallel plate capacitor.

Three Mark Question

5. A capacitor of unknown capacitance is connected across a battery of V volts. The charge stored in it is 300 μC. When potential across the capacitor is reduced by 100 V, the charge stored in it becomes 100 μC. Calculate the potential V and the unknown capacitance. What will be the charge stored in the capacitor if the voltage applied had increased by 100 V?

6. A parallel plate capacitor, each with plate area A and separation d is charged to a potential difference V. The battery used to charge it is then disconnected. A dielectric slab of thickness d and dielectric constant K is now placed between the plates. What change, if any, will take place in
   (i) charge on the plates
   (ii) electric field intensity between the plates
   (iii) capacitance of the capacitor
   Justify your answer in each case.

7. Deduce an expression for the electric potential due to an electric dipole at any point on its axis. Mention one contrasting feature of electric potential of a dipole at a point as compared to that due to single charge.
8. Assuming earth to be an isolated conducting sphere of radius 6400 km, what is the capacitance of earth?
9. An isolated sphere has a capacitance of 50pF.Calculate its radius. How muchcharge should be placed on it to raise its potential to 10^4V?

10. Twenty seven spherical drops, each of radius 3mm and carrying 10^{-12}C of charge arecombined to form a single drop. Find the capacitance and potential of the bigger drop.

11. While travelling back to his residence in the car, Dr. Pathak was caught up in a thunderstorm. It became very dark. He stopped driving the car and waited for thunderstorm to stop? Suddenly he noticed a child walking alone on the road. He asked the boy to come inside the car till the thunderstorm stopped. Dr. Pathak dropped the boy at his residence. The boy insisted that Dr. Pathak should meet his parents. The parents expressed their gratitude to Dr. Pathak for his concern for safety of the child.
    Answer the following questions based on the above information:
    (a) Why is it safer to sit inside a car during a thunderstorm?
    (b) Give an example of a similar action on your part in the past from everyday life.

Five Mark Questions

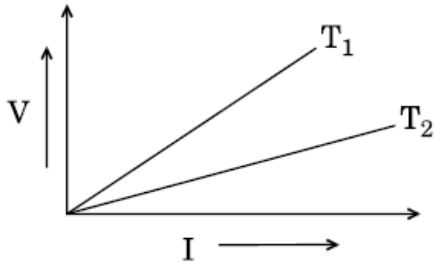
12. Briefly explain the principle of a capacitor. Derive an expression for the capacitance of a parallel plate capacitor, whose plates are separated by a dielectric medium.

13. Derive the expression for the electric potential at a point due to an electric dipole. Mention the contrasting features of electric potential of a dipole at a point as compared to that due to a single charge.

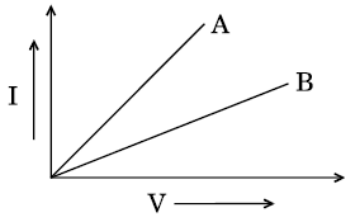
Chapter: CURRENT ELECTRICITY

One Mark Questions

1. Distinguish between emf and terminal voltage of a cell.
2. Show on a graph the variation of resistivity with temperature for a typical semiconductor?
3. Two wires, one of copper and the other of manganin, have same resistance and equal thickness. Which wire is longer? Justify your answer.
4. Define the term ‘mobility’ of charge carriers. Write its S.I. unit.
5. V – I 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 higher and why?



6. Two metallic resistors are connected first in series and then in parallel across a d.c. supply. Plot of I – V graph is shown for the two cases. Which one represents a parallel combination of the resistors and why?



7. 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

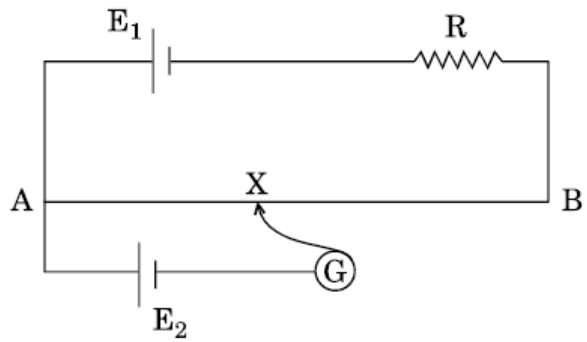
Two Mark Questions

8. Draw a circuit diagram of a potentiometer .State its working principle. Derive the necessary formula to describe how it is used to compare the emfs of the two cells.
9. With the help of the circuit diagram, explain the working Principle of meter bridge. How it is used to determine the unknown resistance of a given wire? Write the necessary precautions to minimize the error in the result.
10. Use Kirchhoff's rules to obtain conditions for the balance condition in a Wheatstone bridge.

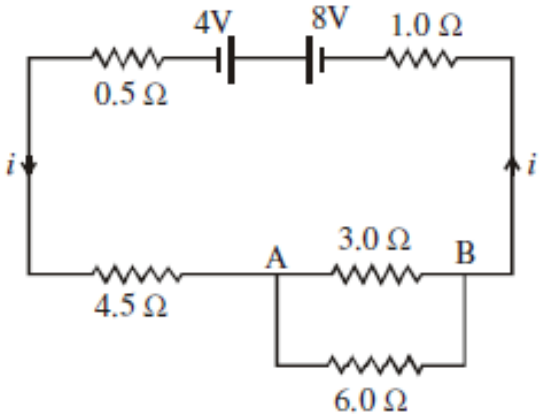
11. Using the concept of drift velocity of charge carriers in a conductor, deduce the relationship between current density and resistivity of the conductor.
12. Define the term 'power loss' in a conductor of resistance R carrying a current I. In what form does this power loss appear? Show that to minimize the power loss in the transmission cables connecting the power stations to homes, it is necessary to have the connecting wires carrying current at enormous high values of voltage.
13. A potentiometer wire of length 1m has a resistance of 10 Ω . it is connected to a 6V battery in series with a resistance of 5Ω . Determine the emf of the primary cell which gives the balance point at 40 cm

Three Mark Questions

14. In the circuit diagram shown, AB is a uniform wire of resistance 15 Ω and length 1 m. It is connected to a cell E_1 of emf 2 V and negligible internal resistance and a resistance R. The balance point with another cell E_2 of emf 75 mV is found at 30 cm from end A. Calculate the value of the resistance R.



15. In the circuit shown in the figure, find the current through each resistor.



16.When a metallic conductor is subjected to a certain potential V across its ends, discuss briefly how the phenomenon of drift occurs. Hence define the term 'drift velocity' of charge carriers and show that the current density j is related to the applied electric field E by the relation $j = \sigma E$ where σ defines the conductivity of the material.

17. Ajit had a high tension tower erected on his farm land. He kept complaining to the authorities to remove it as it was occupying a large portion of his land. His uncle, who was a teacher, explained to him the need for erecting these towers for efficient transmission of power. As Ajit realized its significance, he stopped complaining.
Answer the following questions :
(a) Why is it necessary to transport power at high voltage ?
(b) A low power factor implies large power loss. Explain.

Five Mark Questions

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

(b) Two cells of emfs E1 and E2 and internal resistances r1 and r2 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.

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