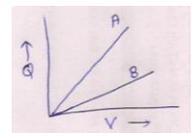
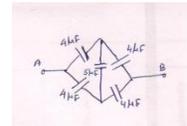


## Assignment of electrostatics

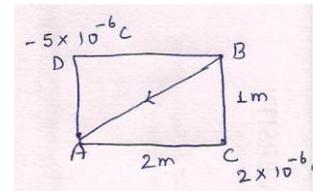
1. Define the term electric dipole moment. Write its S.I unit. Is it a scalar quantity or vector quantity?
2. Define the term electric flux. Write its S.I. unit. Is it a scalar quantity or vector quantity?
3. Dielectric constant of water is 80. What is its permittivity?
4. Name the physical quantity whose S.I. unit is  $\text{NC}^{-1}$ .
4. How does a torque affect the dipole in an electric field?
5. What is the nature of symmetry of field due to a point charge?
6. At what points, dipole field intensity is parallel to the line joining the charges?
7. When is an electric dipole in unstable equilibrium in an electric field?
8. Vehicles carrying inflammable materials usually have metallic ropes touching the ground during motion. Why?
9. State the limitations of Coulomb's law.
10. Find out electric field strength at any point on any line of an electric dipole. Hence, find out electric field on (i) axial line and (ii) equatorial line.
11. Obtain an expression for the torque on an electric dipole in a uniform electric field and give its unit.
12. Sketch the electric lines of force due to point charges (i)  $q > 0$  (ii)  $q < 0$ .
13. An electric dipole of dipole moment  $20 \times 10^{-6} \text{ Cm}$  is enclosed by a closed surface. What is the net flux coming out of the surface?
14. A charge is placed at the centre of a cube. What is the electric flux passing through each face of the cube?
15. Use 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 and inside the shell. Draw a graph showing the variation of electric field with  $r$ , for  $r > R$  and  $r < R$ .
16. Use Gauss's law prove that the electric field due to a uniformly charged infinite plane sheet is independent of the distance from it.
17. Use Gauss's theorem deduce an expression for the electric field intensity at any point due to a thin infinitely long wire of charge /length is  $\lambda \text{ C/m}$ .
18. What is the shape of the equipotential surfaces for a uniform electric field ?
19. What is the shape of equipotential surfaces for an isolated point charge ?
20. Name the physical quantity whose S.I. unit is  $\text{J/C}$  ?
21. Does the electric potential increase or decrease along the electric line of force ?
22. Is electric potential at any point in space necessarily zero if intensity of electric field at that point is zero ?
23. Draw equipotential surfaces for a system consisting of two charges  $Q, -Q$  separated by a distance ' $r$ ' in air.
24. What is the workdone in moving a test charge  $q$  through a distance of 1 cm along the equatorial axis of an electric dipole?
25. State four properties of an equipotential surfaces.
26. Write the dimensional formula of electric potential.
27. Define electric potential of a charge at a point and derive an expression for it.
28. Two charges  $-q$  and  $+q$  are located at points  $A(0,0,-a)$  and  $B(0,0,+a)$  respectively. How much work is done in moving a test charge from point  $P(7,0,0)$  to  $Q(-3,0,0)$ ?
29. What is the net charge on a charged capacitor ?
30. The graph shows the variation of voltage ' $V$ ' across the plates of two capacitors A and B versus increase of charge ' $Q$ ' stored on them. Which of the two capacitors has higher capacitance ? Give reason for your answer.
31. An earthed metal plate is brought near the top of a positively charged gold leaf electroscope . What is the effect on the following ?
  - (a) Charge on the electroscope.
  - (b) Potential of the electroscope.
  - (c) Capacitance of the electroscope.
32. Where does the energy of a capacitor reside?



33. Why is it not possible to make a spherical conductor of capacity one farad ?
34. A parallel plate capacitor with air as dielectric is charged by a dc source to a potential  $V$ . Without disconnecting the capacitor from the source, air is replaced by another dielectric medium of dielectric constant  $K$ . State with reason, how does (i) potential difference (ii) electric field between the plates (iii) capacitance (iv) charge and (v) energy stored in the capacitor change.
35. Two spheres of copper of the same radii, and hollow and the other solid, are charged to the same potential. On which sphere there is more charge ?
36. Derive an expression for the energy stored in a parallel plate capacitor with air between the plates.
37. Two spherical conductors of radii  $R_1$  and  $R_2$  are charged. If they are connected by a conducting wire, what is the ratio of the surface charge densities ?
38. Explain the principle of a device that can build up high voltages of the order of a few million volts. Draw a diagram and explain the working of this device.
39. A 600 pF capacitor is charged by a 200 V supply. It is then disconnected from the supply and is connected to another uncharged 600 pF capacitor. How much electrostatic energy is lost in the process ?
40. Calculate the effective capacitance between A and B in the network as shown in figure.



41. A slab of material of dielectric constant  $K$  has the same area as the plates of a parallel plate capacitor but has a thickness  $\frac{3}{4}d$  where  $d$  is the separation of the plates. How is the capacitance changed when the slab is inserted between the plates?
42. The electric field outside a charged long straight wire is given by  $E = \frac{1000}{r} \text{ V m}^{-1}$  and is directed outwards. What is the sign of the charge on the wire? If two points A and B are at distances 0.2 m and 0.4 m respectively from the wire, then calculate  $V_B - V_A$ .
43. An electric dipole of length 8 cm, when placed with its axis making an angle of  $60^\circ$  with a uniform electric field experiences a torque of  $8\sqrt{3} \text{ Nm}$ . Calculate the (i) magnitude of the electric field (ii) potential energy of the dipole, if the dipole has charges of  $\pm 4 \text{ nC}$ .
44. Given :  $q_1 = -5 \times 10^{-6} \text{ C}$  and  $q_2 = +2 \times 10^{-6} \text{ C}$ .
- (i) Calculate the electric potential at corner B of the rectangle.
- (ii) Calculate the potential at corner A of the rectangle.
- (iii) Calculate the work done in moving a third charge  $q_3 = 3 \times 10^{-6} \text{ C}$  from B to A along the diagonal of the rectangle.



45. If the potential in the region of space near the point  $(-2\text{m}, 4\text{m}, 6\text{m})$  is  $V = 80x^2 + 60y^2$  volt, what are the three components of the electric field at that point ?
46. A hexagon of side 0.1 m has a charge  $10 \mu\text{C}$  at each of its vertices. Determine the potential at the centre of the hexagon.
47.  $N$  charged spherical water drops, each having radius  $r$  and charge  $q$ , coalesce into single big drop. What is the potential of the big spherical drop ?
48. Two point charges  $4 \mu\text{C}$  and  $-2 \mu\text{C}$  are separated by a distance of 1m in air. At what point on the line joining the charges is the electric potential zero ?
49. A charge of  $5 \times 10^{-5}$  coulomb has been distributed between two spheres such that they repel each other with a force of 1 Newton when their centres are 2 metre apart. Find the distribution.
50. Two free charges  $+q$  and  $+4q$  are placed at a distance  $l$  apart. Find the magnitude, sign location of a third charge which makes the system in equilibrium.
51. Determine the magnitude of an electric field that will balance the weight of an electron.
52. An electric dipole of length 2 cm is placed with its axis making an angle of  $30^\circ$  to a uniform electric field of  $10^5 \text{ N/C}$ . If it experiences a torque of  $10\sqrt{3} \text{ Nm}$ , Calculate the magnitude of charge on dipole.