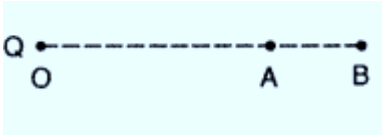
CLASS XII : ASSIGNMENT : CH-2 : ELECTROSTATIC POTENTIAL AND CAPACITANCE : PHYSICS

Electric Potential

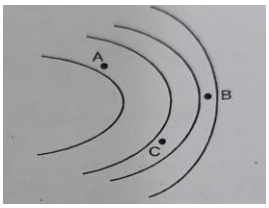
1. Name the physical quantity whose S.I. unit is JC^{-1}. Is it a scalar or a vector quantity?
2. A hollow metal sphere of radius 5 cm is charged such that potential on its surface is 10 V. What is the potential at the centre of the sphere?
3. A point charge +Q is placed at a pont O as shown in the figure. Is the potential difference $V_A - V_B$ positive, negative or zero? if Q is (i) positive (ii) negative?



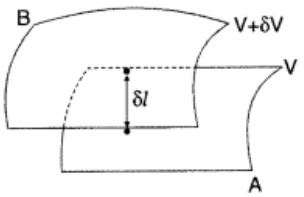
4. Two charges 3 x 10^{-8} C and -2 x 10^{-8} C are located 15 cm apart. At what point on the line joining the two charges is the electric potential zero?
5. Three equal charges, 1 x 10^{-8} C each, are held fixed at the three corners of an equilateral triangle of side 20 cm. Find the electric field and electric potential at the center of the triangle.
6. Two thin concentric shells of radii r_1 and r_2 ($r_2 > r_1$) have charges q_1 and q_2. Write the expression for the potential at the surface of inner and outer shells.
7. Draw a plot showing the variation of www.physicsinduction.com
   (i) electric field (ii) electric potential
   with distance r due to a point charge Q.

Equipotential Surface

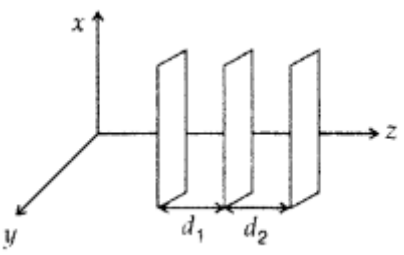
8. Why are electric field lines perpendicular at a point on an equipotential surface of a conductor?
9. Draw the equipotential surface for a uniform electric field in X-direction.
10. Two charges 2μC and – 2μC are placed at points A and B 5 cm apart. Depict an equipotential surface of the system.
11. "For any charge configuration, equipotential surface through a point is normal to the electric field."
12. Some equipotential surfaces are shown in figure. What is the correct order of electric field. www.physicsinduction.com



13. Two closely spaced equipotential surfaces A and B with potentials V and V + δV, (where δV is the change in V), are kept δl distance apart as shown in the figure.
    Deduce the relation between the electric field and the potential gradient between them. Write the two important conclusions concerning the relation between the electric field and electric potentials.



14. Draw 3 equipotential surfaces corresponding to a field that uniformly increases in magnitude but remains constant along Z-direction. How are these surfaces different from that of a constant electric field along Z-direction?



Relation between Electric field intensity and Electric potential

15. Why must the electrostatic potential inside a hollow charged conductor be the same at every point?
16. A uniform electric field of 10 N/C exists in the vertically downward direction. Find the increase in the electric potential as one goes up through a height of 50 cm.
17. The electric potential V at any point (x, y, z) in space is given by $V = 4x^2$ volt. Calculate the electric intensity at the point (1m, 0, 2m).
18. $V = x^2 + y$, find **E**.www.physicsinduction.com
19. For given **E** = 2x i + 3y j, find the potential at (x,y), at origin is 5 V.
20. The electric potential in a region is represented as V = 2x + 3y –z. obtain expression for the electric field strength.
21. Electric potential for a point (x, y, z) is given by $V = 4x^2$ Volt. Find the electric field at point (1, 0, 2).
22. Potential in the x-y plane is given as $V = 5(x^2 + xy)$ volt. Find the electric field at the point (1, -2).

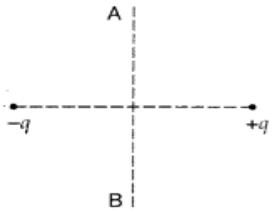
Electric Potential Energy

23. An electron is accelerated through a potential difference V. Write the expression for its speed if it was initially at rest.
24. 5 J of work is done in moving a positive charge of 0.5 C between two points. What is the potential difference between these points?
25. Two point charges, $q_1 = 10 \times 10^{-8}$C, $q_2 = -2 \times 10^{-8}$C are separated by a distance of 60 cm in air.
    (i) Find at what distance from the 1st charge, q_1 would the electric potential be zero.
    (ii) Also calculate the electrostatic potential energy of the system.
26. Determine the electric potential energy of a system consisting of two charges 7μC and -2μC (with no external field) placed at (-9cm, 0, 0) and (9cm, 0, 0) respectively.
    (i) How much work is required to separate the two charges infinitely away from each other?
    (ii) Suppose, now the same system of charges is now placed in an external electric field $E = A(1/r^2)$, $A = 9 \times 10^5$ C/m^2. What would be the electric potential energy of the configuration be?
27. 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)?
28. Three charges +q, 2q and - 4q are placed on the three vertices of an equilateral triangle of each side 0.1 m. Calculate the electrostatic potential energy of the system, take $q = 10^{-7}$C
29. A 500 μC charge is at the centre of a square of side 10 cm. Find the work done in moving a charge of 10 μC between two diagonally opposite points on the square.
30. A charge Q is placed at the centre of a circle of radius r. what will be the work done in taking the charge q at A to a diametrically opposite point B? www.physicsinduction.com

Electric Dipole

31. What are the points at which electric potential of a dipole has (i) maximum value (ii) minimum value?
32. Show on a plot the nature of variation of the Electric field (E) and potential (V), of a (small) electric dipole with the distance (r) of the field point from the centre of the dipole.
33. Write the expression for the work done on an electric dipole of dipole moment p in turning it from its position of stable equilibrium to a position of unstable equilibrium in a uniform electric field E.
34. An electric dipole is placed in a uniform electric field **E** with its dipole moment p parallel to the field. Find
    (i) the work done in turning the dipole till its dipole moment points in the direction opposite to **E** .
    (ii) the orientation of the dipole for which the torque acting on it becomes maximum.
35. What is the work done in moving a test charge q through a distance of 1 cm along the equatorial axis of an electric dipole?

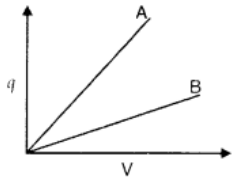
36. A charge 'q' is moved from a point A above a dipole of dipole movement 'p' to a point B below the dipole in equatorial plane without acceleration. Find the work done in the process.



37. An electric dipole of length 4 cm, when placed with its axis making an angle of 60° with a uniform electric field, experiences a torque of 4√3 Nm. Calculate the potential energy of the dipole, if it has charge ± 8 nC.

Capacitance

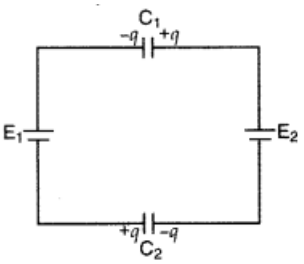
38. Sketch a graph to show how charge Q given to a capacitor of capacity C varies with the potential difference V.
39. Why does current in a steady state not flow in a capacitor connected across a battery? However momentary current does flow during charging or discharging of the capacitor. Explain.
40. A potential difference of 250 V is applied across the plates of a capacitor of 10 pF. Calculate the charge on the plates of capacitor.
41. Diameter of a spherical conductor is 1 m. What is its capacity?
42. The given graph shows variation of charge 'q' versus potential difference 'V' for two capacitors C_1 and C_2. Both the capacitors have same plate separation but plate area of C_2 is greater than that of C_1. Which line (A or B) corresponds to C_1 and why?



43. Net capacitance of three identical capacitors in series is 1 pF. What will be their net capacitance if connected in parallel? Find the ratio of energy stored in the two configurations if they are both connected to the same source.
44. A capacitor of unknown capacitance is connected across a battery of V volts. The charge stored in it is 360μC. When the potential difference across the capacitor is reduced by 120 V, the charge stored in it becomes 120 μC. Calculate (i) the potential V and the unknown capacitance C. (ii) What will be the charge stored in the capacitor, if the voltage applied had increased by 120 V?
45. Calculate the capacitance of a parallel plate condenser of two plates 100 cm X 100 cm each separated by 2 mm thick glass sheet of K = 4.
46. The capacity of a capacitor becomes 10μF when air between the plates is replaced by a dielectric slab of K = 2. What is the capacity of the condenser with air in between the plates?
47. Two parallel plate X and Y capacitors, X and Y, have the same area of plates and same separation between them. X has air between the plates while Y contains a dielectric medium of $\varepsilon_r = 4$. (i) Calculate capacitance of each capacitor if equivalent capacitance of the combination is 4 μF. (ii) Calculate the potential difference between the plates of X and Y. (iii) What is the ratio of electrostatic energy stored in X and Y?
48. (ii) Find the ratio of the potential differences that must be applied across the parallel and series combination of two capacitors C_1 and C_2 with their capacitances in the ratio 1 : 2 so that the energy stored in the two cases becomes the same.
49. A parallel plate capacitor of capacitance C is charged to a potential V by a battery. Without disconnecting the battery, the distance between the plates is tripled and a dielectric medium of k = 10 is introduced between the plates is tripled and a dielectric medium of k = 10 is introduced between the plates of the capacitor. Explain giving reasons, how will the following be affected:
(i) capacitance of the capacitor
(ii) charge on the capacitor, and

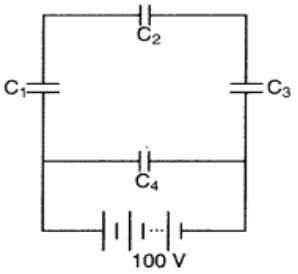
(iii) energy density of the capacitor.

50. Determine the potential difference across the plates of the capacitor 'C_1' of the network shown in the figure.

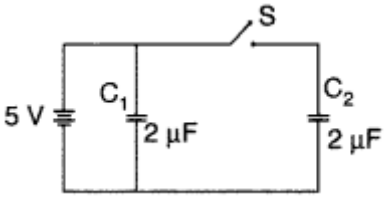


[Assume $E_2 > E_1$]
www.physicsinduction.com

51. A network of four capacitors, each of capacitance 15 µF, is connected across a battery of 100 V, as shown in the figure. Find the net capacitance and the charge on the capacitor C_4.

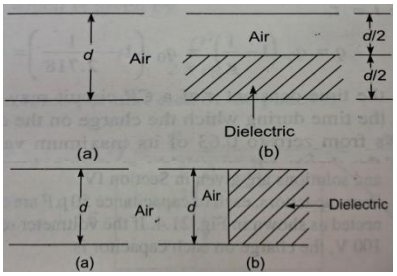


52. Figure shows two identical capacitors C_1 and C_2, each of 2 µF capacitance, connected to a battery of 5 V. Initially switch 'S' is left open and dielectric slabs of dielectric constant K = 5 are inserted to fill completely the space between the plates of the two capacitors. How will the charge and potential difference between the plates of the capacitors be affected after the slabs are inserted?

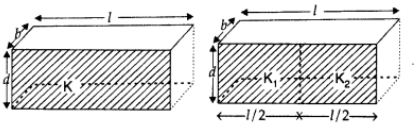


53. A parallel plate air filled capacitor shown in figure has a capacitance of 2µF. When it is half filled with a dielectric of dielectric constant K =3. Find the new capacitance.

54. A parallel plate air filled capacitor shown in figure has a capacitance of 2µF. When it is half filled with a dielectric of dielectric constant K =3. Find the new capacitance.



55. Two identical capacitors of plate dimensions l × b and plate separation d have di-electric slabs filled in between the space the plates as shown in the figure.
Obtain the relation between the dielectric constants K, K_1 and



56. The electric field inside a parallel plate capacitor is E. find the amount of work done in moving a charge q over a closed rectangular loop abcda. www.physicsinduction.com