CLASS XII : ASSIGNMENT : CH-1 : ELECRIC CHARGES AND FIELDS : PHYSICS

Electric Charge

1. Which charge has higher value +4C or -4C?
2. Does the charge given to a metallic sphere depend on whether it is hollow or solid? Give reason for your answer.
3. Why repulsion is the surest test of electrification?
4. Why does charge reside on the outer surface of a conductor?
5. Is a charge of 5.8 X 10^{-18} C possible?
6. A copper sphere of mass 2 g contains nearly 2 x 10^{22} atoms. The charge on the nucleus of each atom is 29 e. What fraction of the electrons must be removed from the sphere to give it a charge of +2μC?

Electrostatic Force

7. What is the relevance of large value of K (=81) for water?
8. If $q_1q_2 < 0$, what is the nature of electrostatic force?
9. How should we divide a charge Q to get a maximum repulsion between them?
10. Electrostatic force between two charges placed in vacuum is F. If the charges are placed at the same distance (separation) in a medium of dielectric constant (relative permittivity) K. what will be the force between them?
11. Plot a graph showing the variation of Coulomb force (F) versus ($1/r^2$), where r is the distance between the two charges of each pair of charges: (1μC, 2μC) and (2μC, – 3μC). Interpret the graphs obtained.
12. Two charged objects have an attractive force of 0.080 N. If the distance separating the objects is quadrupled, then what is the new force?
13. Calculate the electrical force of attraction between two balloons with separate charges of + 3.5 X 10^{-8} C and - 2.9 x 10^{-8} C, when separated by a distance of 0.65 m.
14. Calculate the electrostatic force between two α particles separated by a distance of 3.2 x 10^{-15} m?
15. In a medium the force of attraction between two point electric charges distance d apart is F. What distance apart should these be kept in the same medium so that the force between these becomes 3F?
16. Two equal point charges (10^{-3}C) are placed 1 cm apart in medium of dielectric constant K = 5.
    i. Find the interaction force between the point charges.
    ii. Net force on any of the charge.
17. Two insulating small spheres are rubbed against each other and placed 1 cm apart. If they attract each other with a force of 0.1 N, how many electrons are transferred from one sphere to the other on rubbing?
18. A charge q is placed at the center of the line joining two equal charges Q. What will be the value of q for the system of three charges to be in equilibrium?
19. Two charges 2 x 10^{-6}C and 1 x 10^{-6}C are placed at a separation of 10 cm. Where a third charge should be placed such that it experiences no net force due to these charges?
20. Two charges 2 x 10^{-6}C and -1 x 10^{-6}C are placed at a separation of 10 cm. Where a third charge should be placed such that it experiences no net force due to these charges?
21. Three equal charges, 2 x 10^{-6}C each, are held fixed at the three corners of an equilateral triangle of side 5 cm. Find the Coulomb force experienced by one of the charges due to the rest two.
22. Four charges each equal to –Q is placed at the corners of a square and a charge +q is placed at the center. If the system is in equilibrium, find the value of q.
23. Four equal charges 2 x 10^{-6} C each are fixed at the four corners of a square of side 5 cm. Find the Coulomb force experienced by one of the charges due to the rest three.
24. Two equal like charges in air repel each other with a force of F. By what percentage should each charge be reduced so that the force between them in a medium of that dielectric constant 2 reduces by 28%?
25. √3 x 10^{-19} C and – 10^{-6} C are placed at (0, 0, 0) and (1, 1, 1) respectively. Find the force on 2nd charge in vector form.
26. A positively charged object with a charge of + 85nC is being used to balance the downward force of gravity on a 1.8g balloon which has a charge of -63nC. How high above the balloon must the object be held in order to balance the balloon?
27. Ten positively charged particles are kept fixed on the x-axis at points x =10 cm, 20 cm, 30 cm…. 100 cm. The first particle has a charge 1 x 10^{-8}C, the second 8 x 10^{-8}C, the third 27 x 10^{-8}C and so on. The tenth particle has a

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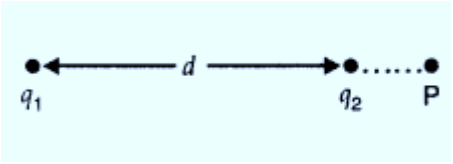
charge of 1000 x 10^{-8}C. Find the magnitude of electric force acting on a 1C charge placed at the origin.

Charge Density

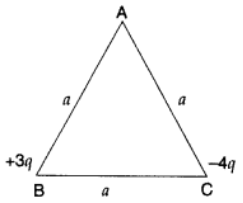
28. What is the direction of the electric field at the surface of a charged conductor having charge density $\sigma < 0$?
29. Two charged spherical conductors of radii R_1 and R_2 when connected by a conducting wire acquire charges q_1 and q_2 respectively. Find the ratio of their surface charge densities in terms of their radii.

Electric field

30. Why should electrostatic field be zero inside a conductor?
31. Why do the electric field lines not form closed loops?
32. Why do the electric field lines never cross each other?
33. When are the electric lines of force i. straight ii. curved
34. If number of electric lines of force from charge q are 10. Then, find out number of electric lines of force from 2q charge.
35. A point charge +Q is placed in the vicinity of a conducting surface. Draw the electric field lines between the surface and the charge.
36. A positive point charge (+ q) is kept in the vicinity of an uncharged conducting plate. Sketch electric field lines originating from the point on to the surface of the plate. Derive the expression for the electric field at the surface of a charged conductor.
37. Is the electric field due to a charge configuration with total charge zero, necessarily zero? Justify.
38. Determine the magnitude of an electric field that will balance the weight of an electron.
39. Two point charges 4 pC and +1 pC are separated by a distance of 2 m in air. Find the point on the line-joining charges at which the net electric field of the system is zero.
40. Two point charges q_1 and q_2 are placed at a distance d apart as shown in the figure. The electric field intensity is zero at a point 'P' on the line joining them as shown. Write two conclusions that you can draw from this.



41. Two point charges +0.2 µC and +0.4µC are placed 0.1m apart. Calculate the electric field at
    i. Midpoint between the charges.
    ii. A point on the line joining the two charges such that it is 0.05 m away from the second charge and 0.15 m away from the first charge.
42. Find out electric field intensity at point A(0, 1m, 2m) due to a point charge -20µC situated at point B(√2m, 0, 1m).
43. Two point charges + 3q and – 4q are placed at the vertices 'B' and 'C' of an equilateral triangle ABC of side 'a' as given in the figure. Obtain the expression for
    (i) the magnitude and
    (ii) the direction of the resultant electric field at the vertex A due to these two charges.



44. A charge is distributed uniformly over a ring of radius 'a'. Obtain an expression for the electric intensity E at a point on the axis of the ring. Hence show that for points at large distances from the ring, it behaves like a point charge.

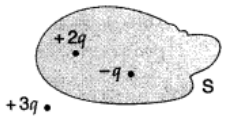
Electric dipole

45. Define the term electric dipole moment of a dipole. State its S.I. unit.
46. What is an ideal dipole?
47. What does $(q_1 + q_2) = 0$ signify?
48. In which orientation, a dipole placed in a uniform electric field is in stable and unstable equilibrium?
49. Derive an expression for the torque experienced by an electric dipole kept in a uniform electric field.
50. Derive the expression for electric field at a point on the equatorial line of an electric dipole.
51. Two charges each of 1µC but opposite in sign are 1 cm apart. Calculate electric field at a point distant 10cm from the midpoint on axial line of the dipole.
52. Two charges 20 µC and -20 µC are held 1 cm apart. Calculate the electric field at a point on the equatorial line at a distance of 50 cm from the center of the dipole.

53. An electric dipole of dipole moment 4 x 10^{-5} Cm is placed in a uniform electric field of 10^{-3} N/C making an angle of 30^0 with the direction of the field. Determine the torque exerted by the electric field on the dipole.

Electric flux

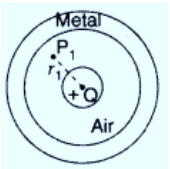
54. Define electric flux. Write its S.I. unit.
55. Why must electrostatic field be normal to the surface at every point of a charged conductor?
56. What is the electric flux through a cube of side 1 cm which encloses an electric dipole?
57. An electric dipole of dipole moment 20 x 10^{-6}Cm is enclosed by a closed surface. What is the net electric flux coming out of the surface?
58. What is the number of electric lines of force that radiate outwards from 1C of charge in Vacuum?
59. Charge q_1 is inside a Gaussian surface. Charge q_2 just outside the surface. Does the electric flux through the surface depend on q_1? Does it depend on q_2? Explain.
60. Figure shows three point charges, +2q, -q and + 3q. Two charges +2q and -q are er within a surface 'S'. What is the electric flux due to this configuration through the surf www.physicsinduction.com



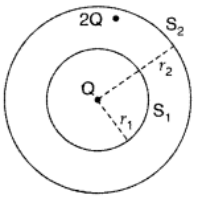
61. What is the flux due to electric field $E=3\times10^3$ i^ N/C through a square of side 10 cm, when it is held normal to it?
62. A charge 'q' is placed at the centre of a cube of side l. What is the electric flux passing through each face of the cube?
63. A charge 'q' is placed at the centre of a cube of side l. What is the electric flux passing through two opposite faces of the cube?
64. Two charges of magnitudes – 2Q and + Q are located at points (a, 0) and (4a,0) respectively. What is the electric flux due to these charges through a sphere of radius '3a' with its centre at the origin?
65. The electric field in a region is given by E = 3/5 E_oi + 4/5 E_oj with E_o = 2 x 10^3N/C. find the flux of this field through a rectangular surface of area 0.2i parallel to the Y-Z plane.
66. Given a uniform electric field E = 5 x 10^3 i N/C. find the flux of this field through a square of 10 cm on a side whose plane is parallel to the y-z plane. What would be the flux through the same square if the plane makes a 30° angle with the x-axis?

Guass law

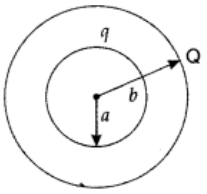
67. How does the electric flux due to a point charge enclosed by a spherical Gaussian surface get affected when its radius is increased? www.physicsinduction.com
68. If the radius of the Gaussian surface enclosing a charge is halved, how does the electric flux through the Gaussian surface change?
69. An infinite line charge produces a field of 9 x 10^4 N/C at a distance of 0.02 m. Calculate the linear charge density.
70. A thin conducting spherical shell of radius R has charge Q spread uniformly over its surface. Using Gauss's law, derive an 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 $0 \le r \le \infty$.
71. A spherical conducting shell of inner radius r_1 and outer radius r_2 has a charge 'Q'. A charge 'q' is placed at the centre of the shell.
    (a) What is the surface charge density on the (i) inner surface, (ii) outer surface of the shell?
    (b) Write the expression for the electric field at a point $x > r_2$ from the centre of the shell.
72. A small metal sphere carrying charge +Q is located at the centre of a spherical cavity in a large uncharged metallic spherical shell. Write the charges on the inner and outer surfaces of the shell. Write the expression for the electric field at the point P_1 www.physicsinduction.com



73. A sphere S_1 of radius r_1 encloses a net charge Q. If there is another concentric sphere S_2 of radius r_2 ($r_2 > r$,) enclosing charge 2Q, find the ratio of the electric flux through S_1 and S_2. How will the electric flux through sphere S_1 change if a medium of dielectric constant K is introduced in the space inside S_2 in place of air? www.physicsinduction.com



74. Two thin concentric and coplanar spherical shells, of radii a and b (b > a) carry charges, q and Q, respectively. Find the magnitude of the electric field, at a point distant x, from their common centre for
    (i) $0 < x < a$
    (ii) $a \le x < b$
    (iii) $b \le x < \infty$



75. A uniformly charged conducting sphere of 2.5 m in diameter has a surface charge density of 100 $\mu C/m^2$. Calculate the
    (i) charge on the sphere
    (ii) total electric flux passing through the sphere
76. Draw a plot showing variation of electric field with distance from the centre of a solid conducting sphere of radius R, having a charge of +Q on its surface.
77. A charge +Q, is uniformly distributed within a sphere of radius R. Find the electric field, due to this charge distribution, at a point distant r from the centre of the sphere where :
    (i) $0 < r < R$ and
    (ii) $r > R$
78. Using Gauss' law in electrostatics, derive an expression for the electric field due to a uniformly changed infinite plane sheet. Prove that the electric field at a point due to a uniformly charged infinite plane sheet is independent of the distance from it.
    (c) How is the field directed if
79. (i) the sheet is positively charged, www.physicsinduction.com
    (ii) negatively charged?
80. Use Gauss's law to derive the expression for the electric field between two uniformly charged large parallel sheets with surface charge densities a and -a respectively.
81. Show that the electric field at the surface of a charged conductor is given by $E=\sigma/\varepsilon_0$ n^, where σ is the surface charge density and h is a unit vector normal to the surface in the outward direction.
82. A thin straight infinitely long conducting wire having charge density X is enclosed by a cylindrical surface of radius r and length l, its axis coinciding with the length of the wire. Find the expression for the electric flux through the surface of the cylinder.
83. A thin straight infinitely long conducting wire of linear charge density 'X' is enclosed by a cylindrical surface of radius V and length 'l'—its axis coinciding with the length of the wire. Obtain the expression for the electric field, indicating its direction, at a point on the surface of the cylinder.
84. A hollow cylindrical box of length 1m and area of cross-section 25 cm^2 is placed in a three dimensional coordinate system as shown in the figure. The electric field in the region is given by **E**=50x i where E is in NC^{-1} and x is in metres.
    Find
(a) Net flux through the cylinder.
(b) Charge enclosed by the cylinder.
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