CLASS XII
CHAPTER 1.Electric Charges and Fields

---

SECTION A CONCEPTUAL AND APPLICATION TYPE QUESTIONS

|		
1	Is the force acting between two point charges q_1 and q_2 kept at some distance apart in air attractive or repulsive when i) $q_1 q_2 > 0$ ii) $q_1 q_2 < 0$?	1 (2007)
2	If the distance between two equal point charges is doubled and their individual charges are also doubled ,what would happen to the force between them ?	1(2014)
3	Do the electrostatic field lines form closed loops?	1(2014)
4	A hollow metal sphere of radius 5cm is charged such that the potential on its is 10V. What is the electric field at the centre of the sphere?	1(2011)
5	What is meant by the statement that "the electric field of a point charge has spherical symmetry whereas electric field due to an electric dipole is cylindrically symmetrical'' ?	1(1996)
6	Why is it difficult to perform electrostatic experiments on a humid day?	1
7	The distance of the field point on the equatorial plane of a small electric dipole , is halved. By what factor will the electric field , due to the dipole change?	1
8	What is the precaution to be taken in selecting the Gaussian surface , regarding the charge ?	1
9	For a system of two point charges +5μC and – 3μC separated by a distance of d apart , draw electric lines of forces	1
10	Two point charges of unknown magnitude and sign are placed some distance apart. The intensity of electric field is zero at a point on the line joining them i) between them at midpoint of the line joining them ii) not between them. What do you infer about their sign and magnitude of the two point charges in each case?	1
11	State two points of difference between charging by induction and charging by conduction .	1
12	Two protons are brought nearer; how does the potential energy of the system change?	1
13	An electron and a proton are brought nearer; how does the potential energy of the system change?	1
14	Which among the following molecules has HCl , CH_4 i) zero dipole moment ii) non zero dipole moment ?	1
15	Why the dielectric constant of water is as high as 81 ,while that of mica it is 6?	1
16	What is the effect of motion on charge q and a mass m of an electron moving with a speed of 10^4 m/s?	1

---

17 Which among the following electric field , potential is /are discontinuous across the surface of   1
    a charged conductor?

18 A spherical rubber balloon carries a charge which is uniformly distributed over its surface . If   1
    the balloon is inflated further so that its volume becomes eight times its original volume ,
    how would the electric flux change?

19 Can a charge exists without mass ? Justify.   1

20 What is the dielectric constant of a metallic conductor?   1

21 A spherical conducting shell of inner radius r_1 and outer radius r_2 has a charge 'Q'. A charge 'q'   2(2010)
    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.

22 Two small identical electrical dipoles AB and CD, each of dipole moment 'p' are kept at an   2(2011)
    angle of 120° as shown in the figure. What is the resultant dipole moment of this
    combination? If this system is subjected to electric field ($\vec{E}$) directed along + X direction, what
    will be the magnitude and direction of the torque acting on this?
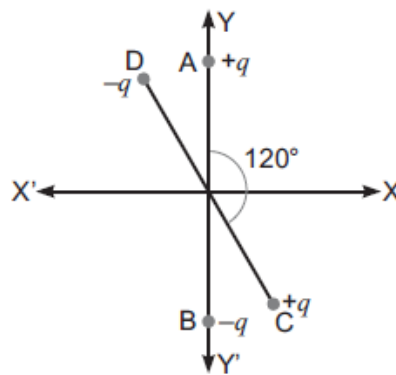
23 Two uniformly large parallel thin plates having charge densities +σ and –σ are kept in the X-Z   2(2011)
    plane at a distance 'd' apart. Sketch an equipotential surface due to electric field between the
    plates. If a particle of mass m and charge '–q' remains stationary between the plates, what is
    the magnitude and direction of this field?

24 i) A point charge (+Q) is kept in the vicinity of uncharged conducting plate. Sketch electric field   3(2014)
    lines between the charge and the plate.

    ii)Two infinitely large plane thin parallel sheets having surface charge densities σ_1 and σ_2 ,(σ_1
    > σ_2) are shown in the figure. Write the magnitudes and directions of the net fields in the
   regions marked II and III.
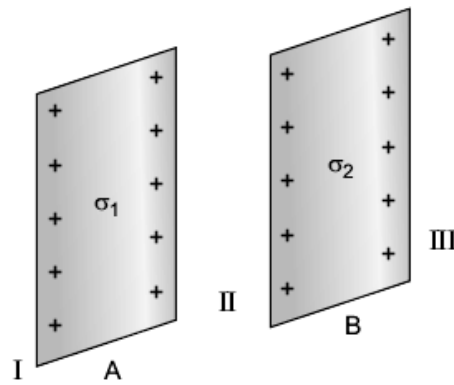
25 Three concentric metallic shells A, B and C of radii a, b and c (a < b < c) have surface charge   3(2014)
   densities +σ, -σ and + σ respectively as shown in the figure.
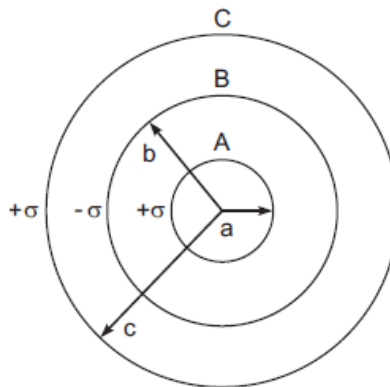
    If shells A and C are at the same potential, then obtain the relation between the radii a, b and
    c.

26 In a type of charge configuration electric field at a point due to it is   2
    i) independent of distance from the point
    ii) inversely proportional to the distance from the point
    iii) inversely proportional to the square of distance from the point
    iv) inversely proportional to the cube of distance from the point
    Identify the type of charge configuration in each case.

27 Draw or describe schematically equi potential surface for the following cases   2
    i) uniform electric field along z- direction
    ii) an electric field that uniformly increases in magnitude but remains same in x-direction

28 The figure below shows tracks of three charged particles in a uniform electro static field. Give   2
    the signs of the three charges. Which particle has the highest charge to mass ratio?
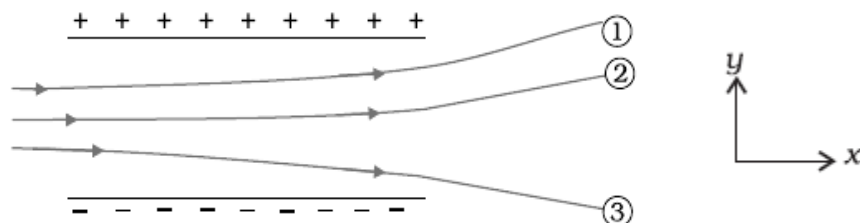

29 In the figure shown, calculate the total electric flux of the electric field through the spheres S_1
    and S_2. The wire AB is of linear density λ given by $\lambda = kx$, where x is the distance measured
   along the wire from the end A
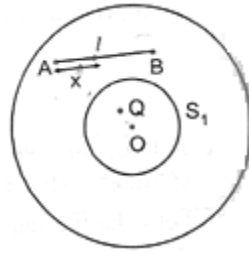
30 Two concentric metallic spherical shells of radii R and 2R are given charges Q1 and Q2 respectively.
The surface charge densities on the outer surfaces of the shells are equal. Determine the ratio Q1 : Q2.

SECTION B   NUMERICAL PROBLEMS

1 An infinite line charge produces a field of 9×10^4 N/C at a distance of 2cm. Calculate the linear charge density.   1

2 Four point charges q_A = 2 µC, q_B = –5 µC, q_C = 2 µC, and q_D = –5 µC are located at the corners of a square ABCD of side 10 cm. What is the force on a charge of 1 µC placed at the centre of the square?   1

3 Three small identical conducting spheres have charges -3×10^{-12}C, 8×10^{-12}C and   2

4×10^{-12}C respectively. They are brought in contact and then separated. Calculate (i) charge on each sphere after separation (ii) number of electrons in excess or deficit on each sphere after separation .

4   Figure below shows situations in which four charged particles are evenly spaced to the left and right of a central point. The charge values are indicated. Rank the situations according to the magnitude of the net electric field at the central, point, Increasing order.   2
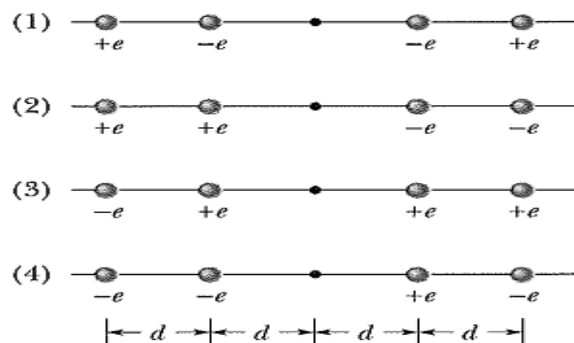
5 A hollow conducting sphere of radius 8cm is given a charge 16µC.What is the electric field intensity i) at the centre of the sphere ii) on the outer surface of the sphere and iii) at a distance of 16cm from the centre of the sphere?   2

6 Four charges of -2q, q, -q and 2q are at the corners of a square ABCD ,of side 20cm, find the magnitude and the direction of the electric field at the centre of the square. Take q = 5 µC   3
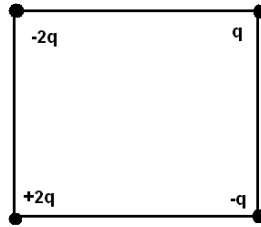
7   A point charge causes an electric flux of -1.0×10^3 Nm^2/C to pass through a spherical   2
    Gaussian surface of 10.0 cm radius with the charge at the centre. What is the value of point
    charge?
    If the radius of the Gaussian surface were doubled, how much flux would pass through the
    surface?

8   Figure shows three point charges, +2q, -q and +3q. Two charges +2q and -q are enclosed within   2
    a surface 'S'. What is the electric flux due to this configuration through the surface 'S'?
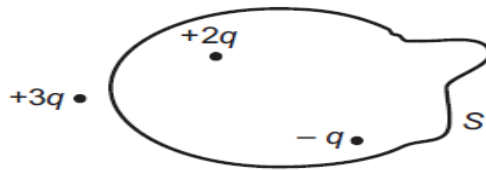
9   Name the charge configuration for which electric field at distances 1cm ,2cm, 3cm are in the   2
    ratio%
        a) 1: 1/8 : 1/27
        b) 1: 1/4 : 1/9

10 The electric field lines on the left have twice the separation of those on the right. If the   2
    magnitude of the field at A is 40N/C , calculate i) the magnitude of the forcce on a proton at
   A .ii) the magnitude of field at B.

11 Two tiny spheres , each having mass m kg and charge q coulomb are suspended from a point   3
    by insulating threads each of l metre length but negligible mass .when the system is in
    equilibrium, each string makes an angle θ with the vertical as shown in the figure. Prove that

    $q^2 = 16mgl^2(\sin^2\theta\tan\theta)\pi\varepsilon_0$
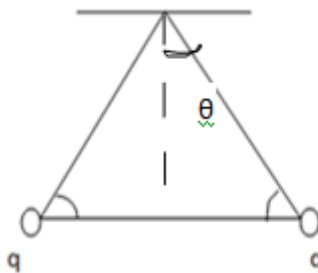

12 A charge of magnitude Q is divided into two parts q and (Q-q) such that the two parts exert   2
   maximum force on each other. Calculate the ratio Q/q

13 An infinite number of charges each of magnitude q ,but consecutive charges of opposite sign   2
are placed along the X –axis at X = 1, 2,4,8 m …..Determine the intensity of electric field at

X = 0 due to these charges.

14 A free pith ball of mass 8g carries a positive charge of 5×10^{-8} C. What must be the nature and   2
the magnitude of   charge that should be given to a second pith ball fixed 5cm vertically below
the first pith ball so that the upper ball is stationary.

15 i) An electric dipole of two opposite charges of same magnitude 2μC   separated by   4cm , is   2
placed   in an electric field of 3×10^{4} V/m ,at an angle of 30∘ .Calculate the torque
experienced by it.

ii) An electric dipole with dipole moment 4×10^{-9} C m is aligned at 30° with the direction of a
uniform electric field of magnitude 5×10^{4} NC^{-1}. Calculate the magnitude of the torque acting
on the dipole.

16 Two point charges +9e and +1e are kept at a distance of 16 cm from each other. At what point   2
between these charges, should a third charge q to be placed so that it remains in equilibrium?
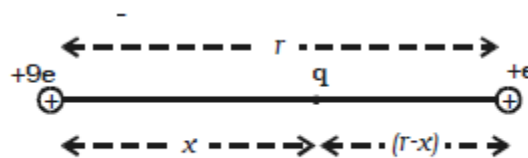
17 A pendulum bob of mass 80 mg , carrying a charge of 2×10^{-8} C is at rest in a horizontal   3
uniform electric field of 2×10^{4} V/m as shown in the figure. Calculate the tension in the thread
of the pendulum and the angle θ it makes with the vertical.
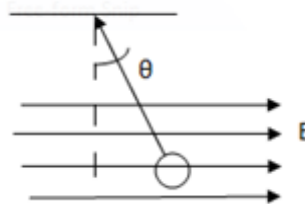
18 Two identical spheres , each of mass 0.1×10^{-3} kg ,carry identical charges and are suspended by   3
two threads of equal length. At equilibrium, they position themselves as shown in the figure.
Calculate the charge on each of them .
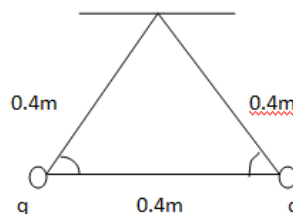
19 Two   electric charges of q and 4q are placed at a distance of 6a apart on a horizontal plane .   2
Find   the point on the line joining them where the resultant electric field is zero.

20 A point charge of 2μC is placed at the centre of a cubical Gaussian surface .Calculate the   2
electric flux passing through i) any one face of the cube ii) entire cube .