CHAPTER-1
ELECTRIC CHARGES AND FIELDS
ASSIGNMENT-3

(1 MARK QUESTION)

1. Consider an uncharged conducting sphere. A positive point charge is placed outside the sphere. The net charge on the sphere is then,

   (a) Negative and uniformly distributed over the surface of sphere.

   (b) Positive and uniformly distributed over the surface of sphere.

   (c) Negative and appears at a point surface of sphere closest to point charge.

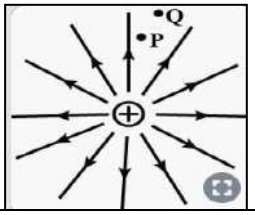
   (d) Zero

2. Why do the electric field lines never cross each other?

3. Two-point charges +8q and -2q are located at x = 0 and x = L respectively. The point on x-axis at which net electric field is zero due to these charges is

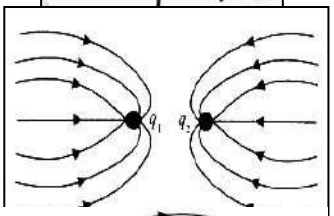
   (a) 8L (b) 4L (c) 2L (d) L

Q4. A point charge +Q is placed in the vicinity of a conducting surface. Draw the electric field lines between the surface and the charge.

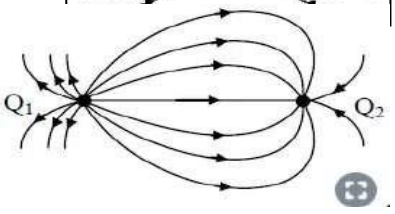


Q5. Figure shows the field lines on a positive charge. Is the work done by the field in moving a small positive charge from Q to P positive or negative? Give reason.

Q6. The following fig. shows electric lines of force due to a point charges q_1 and q_2 placed at points A and B respectively. Write the nature of charge on them.



Q7. A few electric field lines for a system of two charges Q_1 and Q_2 fixed at two different points on the x-axis as shown in the fig. Where can be the electric field due to two charges be zero?



Q8. Two-point charges +8q and -2q are located at x=0 and x =L respectively. The location of a point on x-axis at which the net electric field due to these two-point charges is zero in

a) 2L b) L/4 c) 8L d) 4L

Assertion Reasoning

Q9. **Assertion:** Electric force acting on a proton and e^-, moving in a uniform electric field is same, whereas acceleration of e^- is 1836 times is lighter than that of a proton.

Reason – Electron is lighter than proton.

Q10. **Assertion**- As force is a vector quantity, hence electric field is also a vector quantity.

Reason – The unit of electric field intensity is newton per coulomb.

Q11. **Assertion** – The electric lines of forces from a point charge and can merge at a negativecharge.

Reason – A charge of force to move in electric field moves along an electric line of force.

Q12. **Assertion** – Three equal charges are situated as a circle of radius r such that they form equilateraltriangle, then the electric field intensity at the centre is zero.

Reason – The force on unit positive charge at the centre, due to three equal charges are represented by the three sides of a triangle taken in the same order. Therefore, electric field intensity at centre is zero.

Q13. **Assertion** –A point charge is brought in an electric field. The filed at a nearby point will increase whatever be the nature of the charge.

Reason – The electric field is independent of the nature of charge.

Q14. The electric field in a certain region is acting radially outwards and is given by E= Ar.

A charge contained in sphere of radius 'a' centred at origin of the field will be given by:

(a) Aϵoa2 (b) 4πϵoAa3 (c) ϵoAa3 (d) 4πϵoAa2

Q15. A charge q is placed at the point of intersection of body diagonals of a cube. The electric flux passing through any one of its faces is

(a) $\frac{q}{6g_o}$ (b) $\frac{3q}{g_o}$ (c) $\frac{6q}{g_o}$ (d) $\frac{q}{3g_o}$

Q16. Name the principle which is mathematical equivalent to Coulomb's law and superposition principle.

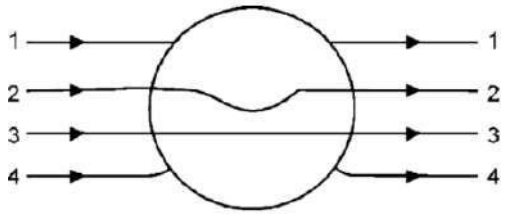
Q17. A charge q is placed at the centre of a cube of side 'l' what is the electric flux passing through two opposite faces of the cube?

Two-mark questions

Q18. State Coulomb's law in vector form and prove that $F_{21} = - F_{12}$**,** where letters have their usual meaning.

Q19. Define electric field intensity. What is its S.I unit? What is the relation between electric field and force?

Q20. An infinite number of charges each equal to 4μc are placed along the x-axis at x=1m, x=2m & x=4m as so on. Find electric field at the origin due to given set of charges.



Q21. A metallic solid sphere is placed in a uniform electric field. The lines of force follow the path shown below. Which field lines follow the path?

Q21. If the total charge enclosed by a surface is zero, does it imply that the electric field everywhere on the surface is zero? Conversely, if the electric field everywhere on a surface is zero, does it imply that net charge inside is zero.

Q24. A wire AB of length L has linear charge density $\lambda=Kx$, where x is measured from the end A of the wire. This wire is enclosed by a Gaussian hollow surface. Find the expression for electric flux through the surface.

Q25.A uniformly charged conducting sphere of 2.4 m diameter has a surface charge density of 180 $\mu C/m^2$.

(a) Find the charge on the sphere.

(b) What is the total electric flux leaving the surface of the sphere?

Q26. A charge of 17.7×10^{-4} C is distributed over a large sheet of area 400 cm^2. Calculate the electric field intensity at a distance of 10 cm from it.

Q27. A large plane sheet of charge having surface charge density 5×10^{-16} Cm^{-2} lies in XY plane. Find electric flux through a circular area of radius 1 cm. Given normal to the circular area makes an angle of 60^o with Z-axis.

Three-mark questions

Q28. Derive an expression for electric field intensity at a point due to (a) A point charge (b) A group of charges (c) Continues charge distribution.

Q29. An electron falls through a distance of 1.5 cm in a uniform electric field of value field is reversed, a proton falls through the same distance. Compare the

time of fall in each case. Contrast the situation with that of free fall under gravity.

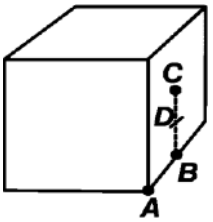
Q30. What will be the total flux through the faces of the cube with side of length a if a charge q is placed at

a) A: a corner of the cube

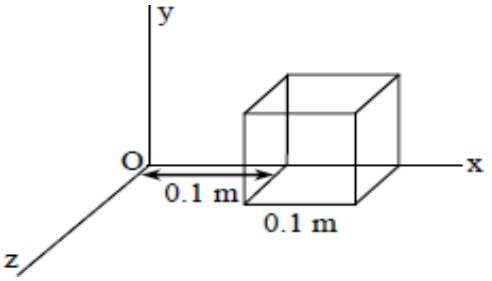
b) B: mid-point of an edge of the cube

c) C: centre of a face of the cube

d) D: mid-point of B and C



Q31. Consider a uniform field $\vec{E} = 30 \times 10^3 \hat{\imath}$ NC^{-1}. Calculate the flux of this field through a square surface area of 100 cm^2



(a) When its plane is parallel to Y-Z plane. (b) When the normal to its plane makes an angle of 60^o with X - axis. (c)When parallel to X-Y plane.

Q32.The electric field components due to a charge inside the cube of side 0.1 m are, $E_x = \alpha x$, where α = 500 N/Cm^{-1}, $E_y = 0$, $E_z = 0$. Calculate flux through the cube and charge inside the cube.

Five-mark questions

Q33. State the principle of superposition and use it to obtain the expression for the total force exerted on a point charge due to an assembly of (N -1) discrete point charges.

Case based question

Q34. Paragraph 1: Coulomb's law

This law is a quantitative statement of about the force between two-point charges. When the linear sizes of charged bodies are much smaller than the distance between them, their sizes may be ignored and the charge bodies are called point charges. After retiring from his active services as a military engineer in 1776, Coulomb discovered a torsion balance to measure a small quantity of force and used it for determination of forces of attraction or repulsion between small charged spheres. He thus arrived in 1785 at the inverse square law relation, now known as Coulomb's law. He found that the force between two-point charges varied inversely with the square of the distance between the charges and was directly proportional to the product of the magnitude of the charges

and acted along the line joining the two charges. Coulomb's law is an electrical analogue of Newton's law of Universal Gravitation in mechanics.

$$| F_1| = |F_2| = k (q_1 \times q_2) / r^2$$

Q1. Answer the following questions

(I) Identify the wrong statement in the following Coulomb's law correctly describes the electric force that

(a) Blinds the electrons of an atom to its nucleus.

(b) Binds the protons and neutrons in the nucleus of an atom.

(c) Binds atoms together to form molecules.

(d) Binds atoms and molecules to form solids.

(II) Two charges 3×10^{-5}C and 5×10^{4}C are placed at a distance 10cm from each other. The value of electrostatic force acting between them is

(a) 13.5×10^{11} N (b) 40×10^{11} N © 180×10^{9} N (d) 13.5×10^{10} N

2. Each of two point charges is doubles and their distance is halved. Force of interaction becomes n times, where n is

(a) 4 (b) 1 (c) 18 (d) 16

3. The minimum value of force acting between two point charges placed 1 m apart from one another is

(a) ke^2 (b) ke (c) ke/4 (d) $ke^2/2$

4. A and B are two identical spherical charged bodies which repel each other with force F, kept at a finite distance. A third uncharged sphere of same size is brought in contact with sphere B and removed. It is then kept at a mid-point of A and B. Find the magnitude of the force on C.

(a) F/2 (b) F/8 (c) F (d) Zero

Q35. Paragraph 2:

Smallest charge that can exist in nature is the charge of an electron. During friction it is the only transfer of electrons which makes the body charged. Hence net charge on any body is an integral multiple of charge of an electron [1.6×10^{-19}C] i.e. I.e. q=ne

Where n=1, 2, 3……

Hence nobody can have a charge represented as 1.1e, 2.7e…etc.

Recently, it has been discovered that elementary particles such as protons or neutrons are composed of more elemental units called quarks.

Q1. Answer the following questions:

1. Which of the following properties is not satisfied by an electric charge?
   (a) Total charge conservation.
   (b) Quantization of charge.
   (c) Two type of charge.
   (d) Circular line of force.
2. Which one of the following charges is possible?
   (a) 5.8×10^{-18}C (b) 3.2×10^{-18}C
   © 4.5×10^{-19}C (d) 8.6×10^{-19}C
3. If a charge on a body is 1nC, then how many electrons present on the body?(a) 6.25×10^{27} (b)1.6×10^{19}
   © 6.25×10^{28} (d) 6.25×10^{9}
4. If a body gives out 10^9 electrons every second, how much time is required to get a totalcharge of 1C from it?
   (a)190.19 years (b)159.12 years
   © 198.19 years (d) 188, 21 years

5.A polythene piece rubbed with wool is found to have a negative charge of 3.2×10^{-7}C.Calculate the number of electrons transferred.

(a) 2×10^{12} (b)3×10^{12}
© 2×10^{14} (d)3×10^{14}