Brain International School

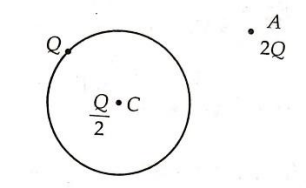
Vikas Puri, New Delhi

ASSIGNMENT NO. 2

SUBJECT: PHYSICS **CLASS-XII** **MAY,2025**

CH: 1 *ELECTRIC CHARGESAND FIELDS*

1. Plot a graph showing the variation of coulomb force (F) versus $\left[\frac{1}{r^2}\right]$, where r is the distance between the two charges of each pair of charges: (1μC, 2μC) and (2μC, −3μC). Interpret with graphs obtained.
2. A thin metallic spherical shell of radius R carries a charge Q on its surface. A point charge $\frac{Q}{2}$ is placed at its centre C and another charge +2Q is placed outside the shell of a distance x from the centre as shown in figure.

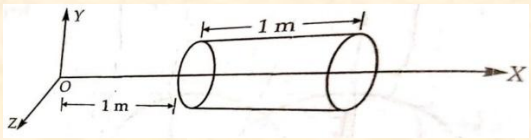


Find

(a) the force on the charge at the centre of shell and at the point A,

(b) the electric flux through the shell.

3. 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 figure. The electric field in the region is given by $\vec{E}$ = 50x $\hat{\imath}$, where E is in NC^{-1} and x is in metres.



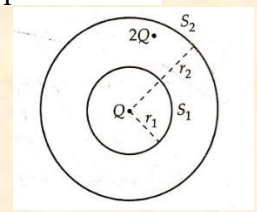
Find

a. Net flux through the cylinder,

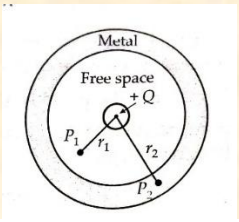
b. charge enclosed by the cylinder.

4. Given a uniform electric field $\vec{E} = 5\times10^3\hat{\imath}\ NC^{-1}$, 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 at 30° angle with the X-axis?
5. Consider a uniform electric field $\vec{E} = 3\times10^3\hat{\imath}\ NC^{-1}$. Calculate the flux of this field through a square surface of area 10 cm^2 when its plane is parallel to the y-z plane, and (ii) the normal to its plane makes a 60° angle with the x-axis.
6. S_1 and S_2 are two concentric spheres enclosing charges Q and 2Q respectively as shown in figure. (i) What is the ratio of the electric flux through S_1 and S_2? (ii) How will the electric flux through the sphere S_1 change, if a medium of dielectric constant κ is introduced in the space inside S_1 in place of

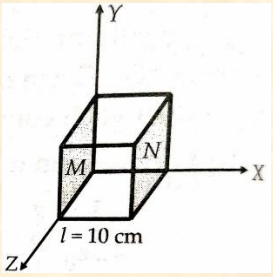
air? (iii) How will the electric flux through a sphere S_1 change, if the medium is dielectric constant κ is introduced in the space inside S_2 in place of air?



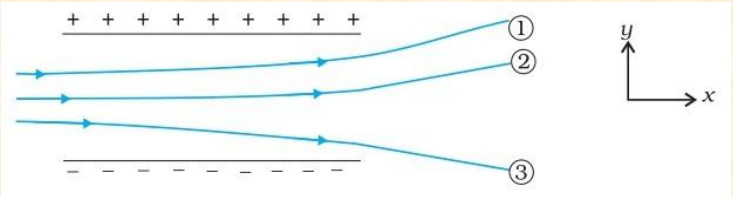
7. A small metal sphere carrying charge +Q is located at the centre of a spherical cavity in a large uncharged metal sphere as shown in figure. Use Gauss's theorem to find electric field at points P_1 and P_2.



8. Electric field in figure is directed along +X direction and given by E_x= 5 Ax + 2 B, where E is in $NC^{-1}$and x is in metre, A and B are constants with dimensions. Taking A= 10 NC^{-1} m^{-1} and B = 5 NC^{-1}, calculate(i) the electric flux through the cube. (ii) net charge enclosed within the cube.

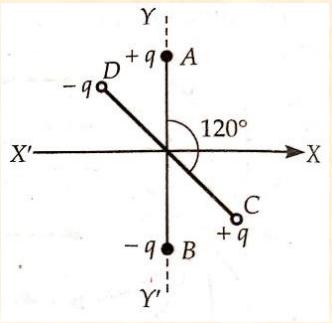


9. A particle of mass m and charge (–q) enters the region between the two charged plates initially moving along x-axis with speed v_x (like particle 1 in Fig.). The length of plate is L and a uniform electric field E is maintained between the plates. Show that the vertical deflection of the particle at the far edge of the plate is $qEL^2/(2mv_x^2)$.



10. An electric dipole is placed at an angle of 60° with an electric field of magnitude 4×10^5 NC^{-1}. It experiences a torque of $8\sqrt{3}$ Nm. If the length of the dipole is 4 cm, determine the magnitude of either charge of the dipole.

11. Two small identical electrical dipoles AB and CD, each of dipole moment 'p' are kept at an angle of 120° as shown in 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?



12. Using Gauss's law, deduce the expression for the electric field due to uniformly charged spherical conducting shell of radius R at a point (i) outside and (ii) inside the shell. Plot a graph showing variation of electric field as a function of r > R and r< R.

CH2: ELECTRIC POTENTIAL AND CAPACITANCE

13. A uniform electric field of 20 N/C exists along the x-axis in space. Find the potential difference $V_A - V_B$ for the point A = (4m, 2m) and B = (6m, 5m).

ANS:$-40\ V$

14. An electric field $\vec{E} = (20\hat{\imath} + 30\hat{\jmath})$ N/C exists in space. If the electric potential at origin is taken to be zero, find the potential at (2m, 2m).

ANS:$-100\ V$

15. An electric field $\vec{E} = Ax\hat{\imath}$ exists in the space, where A=10 vm^{-2}.Take the potential at (10 m, 20 m) to be zero. Find the potential at the origin.

ANS: 500 V

16. An electric field $\vec{E} = (Ax + B)\hat{\imath}$ N/C exists in space. The values of constant are A=20 and B=10. If the electric potential at x=1 is $V_1$and that at x= -5 is V_2, then find $V_1 - V_2$.

ANS: 180 V

17. The potential at any point is given by $V = x(y^2 - 4x^2)$. calculate the Cartesian components of the electric field at the point.

18. The electric potential existing in space is $V = A(xy + yz + zx)$. find the expression for the electric field. If A=10, find the magnitude of the electric field at (1 m, 1 m, 1 m).

ANS: 35N/C

19. Electric potential is given by V=$6x - 8xy^2 - 8y + 6yz - 4z^2$.Find the electric force acting on 2 C point charge placed on origin.

ANS: 20 N

20. The potential function of an electrostatic field is given by $V = 2x^2$.Determine the electric field strength at the point (2 m ,0, 3 m)

ANS: -8 N/C

21. The potential at a point x (measured in μm) due to some charges situated on the x-axis is given by $V(x) = \frac{20}{(x^2-4)}$ volt. Find the electric field E at x = 4μm.

22. What is dielectric? A dielectric slab of thickness t is kept between the plates of a parallel plate capacitor separated by a distance d. Derive the expression for the capacitance of the capacitor for $t \ll d$.