MASTER MENTORS
WORKSHEET

SUBJECT : PHYSICS

CHAPTER : ELECTRIC CHARGES AND FIELDS

1. What is the S.I. unit of Electric Flux?
(a)Nm^2C^{-1} (b) NmC^2 (c) NCm^{-1} (d) NmC^{-1}

2. Electric charges of 1μC, -1μC and 2μC are placed in air at the corners A,B and C respectively of an equilateral triangle ABC having length of each side 10 cm. The resultant force on the charge at C is
A. 0.9 N B 1.8 N C 2.7 N D. 3.6 N

3 AND 4 ARE ASSERTION REASON TYPE QUESTIONS; CHOOSE THE CORRECT OPTION AS PER THE STATEMENTS GIVEN IN ASSERTION AND REASON

3. Assertion (A) : If a proton and an electron are placed in the same uniform electric field, they experience different acceleration.
Reason (R) : Electric force on a test charge is independent of its mass.

a) Assertion and Reason both are correct and R is the correct explanation of A.
b) Assertion and Reason both are correct but R is not the correct explanation of A.
c) Assertion is true but Reason is false.
d) Assertion and Reason both are incorrect.

4. Assertion (A) : The charge given to a metallic sphere does not depend on whether it is hollow or solid.
Reason (R) : Since the charge resides only on the surface of the conductor.
5. Two-point charges 4Q and Q are separated by 1 m in air. At what point on the line joining the charges is the electric field intensity zero?

6. An electric dipole is placed in an uniform electric field. Derive an expression for the torque experienced by it.

7. It is given that λ be the linear charge density of a uniformly charged and infinitely long straight conductor. If r be the distance of a point from this conductor then mathematically show that the electric field at the given point due to this conductor depends on both λ and r. Hence plot a graph between electric field (E) and distance (r).

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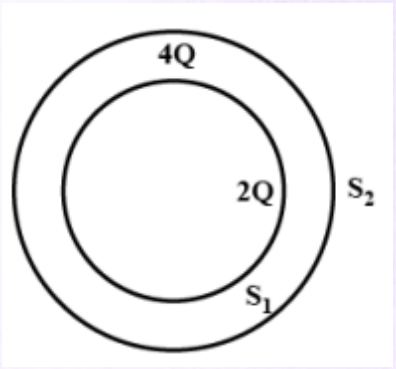
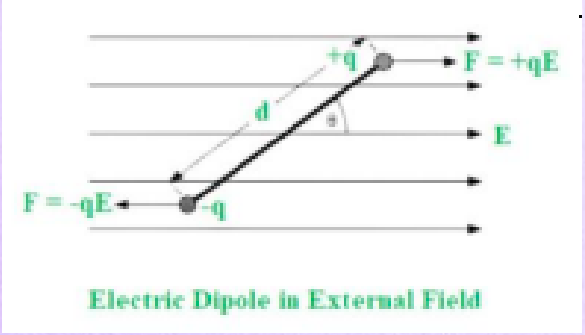
8. Consider two hollow concentric spheres, S1 and S2, enclosing charges 2Q and 4Q respectively as shown in the figure.



Find out the ratio of the electric flux through them.
How will the electric flux through the sphere S1 change if a medium of dielectric constant 'ϵr ' is introduced in the space inside S1 in place of air?

9. Deduce the necessary expression. (3)
(i) Derive an expression for the electric field intensity at a point on the axial line of an electric dipole of dipole moment p and length 2d.What is the direction of this field?
(ii) 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?

10. When electric dipole is placed in uniform electric field, its two charges experience equal and opposite forces, which cancel each other and hence net force on electric dipole in uniform electric field is zero. However these forces are not collinear, so they give rise to some torque on the dipole. Since net force on electric dipole in uniform electric field is zero, so no work is done in moving the electric dipole in uniform electric field. However, some work is done in rotating the dipole against the torque acting on it.



Electric Dipole in External Field

A. The dipole moment of a dipole in a uniform external field $\bar{E}$ is P. Then the torque τ acting on the dipole is
(a) $\tau = P \times E$ (b) $\tau = P.\bar{E}$ (c) $\tau = 2(P + \bar{E})$ (d) $\tau = (P + E)$

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B. An electric dipole consists of two opposite charges, each of magnitude 1.0μC separated by a distance of 2.0 cm. The dipole is placed in an external field of 106 NC-1 . The maximum torque on the dipole is (a) 0.2 × 10-3 Nm (b) 1×10-3 Nm (c) 2 × 10-3 Nm (d) 4 × 10-2 Nm

C. Torque on a dipole in a uniform electric field is minimum when θ is equal to
(a) 0° (b) 90° (c) 180° (d) Both (a) and (c)

D. When an electric dipole is held at an angle in a uniform electric field, the net force F and torque τ on the dipole are (a) F= 0, τ = 0 (b) F≠0, τ≠0 (c) F=0, τ ≠ 0 (d) F≠0, τ=0

E. An electric dipole of moment p is placed in an electric field of intensity E. The dipole acquires a position such that the axis of the dipole makes an angle with the direction of the field. Assuming that potential energy of the dipole to be zero when θ = 90°, the torque and the potential energy of the dipole will respectively be
(a) pEsinθ, - pEcosθ (b) pEsinθ, -2pEcosθ (c) pEsinθ, 2pEcosθ (d) pEcosθ, -pEsinθ