DPP-9

Dipole

Q.1 An electric dipole is placed making at an angle 60° with an electric field of strength 4×10^5 N/C. It experiences a torque equal to $8\sqrt{3}$ N − m. Calculate the charge on the dipole, if it is of length 4 cm.

Q.2 A system has two charges $q_A = 2.5 \times 10^{-7}$C and $q_B = -2.5 \times 10^{-7}$C located at points A ≡ (0,0, −15)cm and B ≡ (0,0,15)cm respectively. What are the total charge and electric dipole moment vector of the system?

Q.3 An electric dipole has the magnitude of its charge as q and its dipole moment is p. It is placed in a uniform electric field E. If its dipole moment is along the direction of the field, the force on it and its potential energy are respectively:-

(A) q. E and p. E (B) zero and minimum

(C) q. E and maximum (D) 2q. E and minimum

Q.4 The electric potential at a point due to an electric dipole will be :

(A) $k\frac{\vec{P}\cdot\vec{r}}{r^3}$ (B) $k\frac{\vec{P}\cdot\vec{r}}{r^2}$ (C) $k\frac{\vec{P}\times\vec{r}}{r^3}$ (D) $k\frac{\vec{P}\times\vec{r}}{r^2}$

Q.5 An electric dipole of moment $\vec{p} = (-\hat{i} - 3\hat{j} + 2\hat{k}) \times 10^{-29}$Cm is at the origin (0,0,0). The electric field due to this dipole at $\vec{r} = +\hat{i} + 3\hat{j} + 5\hat{k}$ (note that $\vec{r} \cdot \vec{p} = 0$) is parallel to

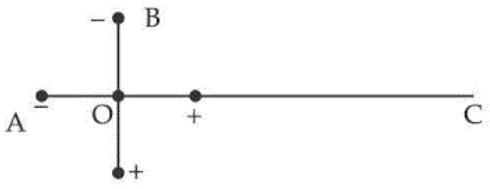
(A) $(+\hat{i} - 3\hat{j} - 2\hat{k})$ (B) $(-\hat{i} - 3\hat{j} + 2\hat{k})$

(C) $(+\hat{i} + 3\hat{j} - 2\hat{k})$ (D) $(-\hat{i} + 3\hat{j} - 2\hat{k})$

Q.6 An electric dipole is placed on x-axis in proximity to a line charge of linear charge density 3.0×10^{-6}C/m. Line charge is placed on z-axis and positive and negative charge of dipole is at a distance of 10 mm from the origin respectively. If total force of 4 N is exerted on the dipole, find out the amount of positive or negative charge of the dipole

(A) 4.44μC (B) 8.8μC (C) 0.485mC (D) 815.1nC

Q.7 Two ideal electric dipoles A and B, having their dipole moment p_1 and p_2 respectively are placed on a plane with their centres O as shown in the figure. At point C on the axis of dipole A, the resultant electric field is making an angle of 37° with the axis. The ratio of the dipole moment of A and B, $\frac{P_1}{P_2}$ is $\left(\text{Take } \sin 37° = \frac{3}{5}\right)$



(A) $\frac{4}{3}$ (B) $\frac{3}{2}$ (C) $\frac{2}{3}$ (D) $\frac{3}{8}$

Q.8 An electric dipole is formed by two equal and opposite charges q with separation d. The charges have same mass m. It is kept in a uniform electric field E. If it is slightly rotated from its equilibrium orientation, then its angular frequency ω is

(A) $\sqrt{\frac{2qE}{md}}$ (B) $\sqrt{\frac{qE}{2md}}$ (C) $2\sqrt{\frac{qE}{md}}$ (D) $\sqrt{\frac{qE}{md}}$

Q.9 When an electric dipole $\vec{p}$ is kept in a uniform electric field $\vec{E}$ then for what value of the angle between $\vec{p}$ and $\vec{E}$, torque will be maximum :-

(A) 90° (B) 0° (C) 180° (D) 45°

Q.10 What will be the ratio of electric field at the axis and at equatorial line of a dipole :-

(A) 1: 2 (B) 2: 1 (C) 4: 1 (D) 1: 4

Q.11 An electric dipole is placed in non uniform electric field, then it experiences :-

(A) no force (B) only torque

(C) only linear resultant force (D) linear resultant force and torque both

Q.12 At the mid point on the axis of an electric dipole

(A) the electric field is zero.

(B) the electric potential is zero.

(C) neither the electric field nor the electric potential is zero.

(D) the electric field is directed perpendicular to the axis of the dipole.

Q.13 The magnitude of charges of electric dipole is 3.2×10^{-19} and distance between them is 2.4Å. If it is placed in a electric field 4×10^5 V/m then its dipole moment is (in C − m)

(A) 9.6×10^{-5} (B) 12.8×10^{-14}

(C) 7.68×10^{-29} (D) 30.72×10^{-24}

Q.14 Three point charges +q, −2q and +q are placed at points $(x = 0, y = a, z = 0)$, $(x = 0, y = 0, z = 0)$ and $(x = a, y = 0, z = 0)$ respectively. The magnitude and direction of the electric dipole moment vector of this charge assembly are :-

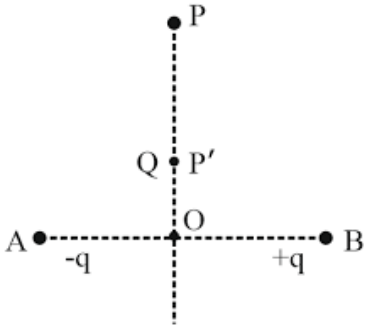
(A) $\sqrt{2}$ qa along +x direction

(B) $\sqrt{2}$ qa 0along +y direction

(C) $\sqrt{2}$ qa along the line joining points $(x = 0, y = 0, z = 0)$ and $(x = a, y = a, z = 0)$

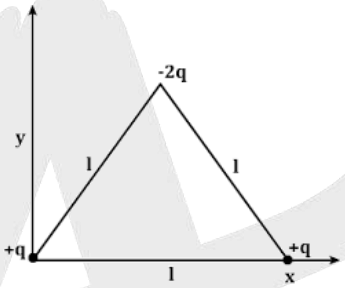
(D) qa along the line joining points $(x = 0, y = 0, z = 0)$ and $(x = a, y = a, z = 0)$

Q.15 Charges −q and +q located at A and B, respectively, constitute an electric dipole. Distance AB = 2a, O is the mid point of the dipole and OP is perpendicular to AB. A charge Q is placed at P where OP = y and $y >> 2a$. The charge Q experiences an electrostatic force F. If Q is now moved along the equatorial line to P′ such that the $OP' = \left(\frac{y}{3}\right)$, force on Q will be close to $\left(\frac{y}{3} >> 2a\right)$



(A) 27F (B) 3F (C) $\frac{F}{3}$ (D) 9 F

Q.16 Determine the electric dipole moment of the system of three charges, placed on the vertices of an equilateral triangle, as shown in the figure.



(A) $2ql\hat{j}$ (B) $(ql)\frac{\hat{i}+\hat{j}}{\sqrt{2}}$ (C) $\sqrt{3}ql\frac{\hat{j}-\hat{i}}{\sqrt{2}}$ (D) $-\sqrt{3}ql\hat{j}$

Q.17 An electric dipole has a fixed dipole moment $\vec{p}$, which makes angle θ with respect to x-axis. When subjected to an electric field $\vec{E}_1 = E\hat{i}$, it experiences a torque $\vec{T}_1 = \tau\hat{k}$. When subjected to another electric field $\vec{E}_2 = \sqrt{3}E_1\hat{j}$ it experiences a torque $\vec{T}_2 = -\vec{T}_1$. The angle θ is

(A) 30° (B) 45° (C) 60° (D) 90°

Q.18 Two opposite and equal charges 4×10^{-8}C when placed 2×10^{-2} cm away form a dipole. If this dipole is placed in an external electric field 4×10^{8} N/C the value of maximum torque and the work done in rotating it through 180 degree will be :-

(A) 64×10^{-4}Nm, 64×10^{-4} J

(B) 32×10^{-4}Nm, 32×10^{-4} J

(C) 64×10^{-4}Nm, 32×10^{-4} J

(D) 32×10^{-4}Nm, 64×10^{-4} J

Q.19 An electric dipole of dipole moment $\vec{p}$ is lying along a uniform electric field $\vec{E}$. The work done in rotating the dipole by 90° is :-

(A) 2pE

(B) pE

(C) $\sqrt{2}$pE

(D) $\frac{pE}{2}$

ANSWER KEY

1. 10^{-3}C or 1mC **2.** Total charge $= 0$; Dipole moment $\vec{p} = -7.5 \times 10^{-8}\text{C} - \text{m}\hat{k}$

3.	(B)	**4.**	(A)	**5.**	(C)	**6.**	(A)	**7.**	(C)	**8.**	(A)	**9.**	(A)
10.	(B)	**11.**	(D)	**12.**	(B)	**13.**	(C)	**14.**	(C)	**15.**	(A)	**16.**	(D)
17.	(C)	**18.**	(D)	**19.**	(B)								