Worksheet - 2

Topic: Electrostatic Field (Num)

1. A system of 2 charges ±5μC are placed 10 cm apart along x axis. Find the electric field
(i) at a distance of 15 cm from the centre of system along x axis
(ii) at a distance of 10 cm from center along y axis.

2. Two point electric charges +q and +4q are separated by a distance of 6a. Find the point on the line joining the two charges where the electric field is zero.

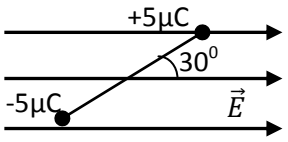
3. Two point charges of +16μC and -9μC are placed 8 cm apart in air. Determine the resultant electric field at a point 4 cm away from -9μC on right side while other charge is on left of it.

4. An electric dipole, when held at 30^0 with respect to a uniform electric field of 10^4 N/C, experiences a torque of $9 \times 10^{-26}\text{Nm}$. Calculate the dipole moment of the dipole.

5. An electric dipole of length 2 cm is placed with its axis making an angle of 60^0 to a uniform electric field of 10^5 N/C. If it experiences a torque of $8\sqrt{3}\,nm$, Calculate the:
(a) Magnitude of the charge on the dipole, and **(b)** potential energy of the dipole.

6. 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 is the total charge and electric dipole moment of the system?

7. An electric dipole consists of +5μC and –5 μC separated by a distance of 2 cm. It is held in a uniform electric field of 50 V/cm, as shown in the figure. Calculate



(a) Dipole moment **(b)** Initial torque on dipole
(c) Initial potential energy of the dipole
(d) Potential energy in stable and unstable equilibrium
(e) Change in the energy if the dipole turns from its initial position and aligns along E
(f) Work done in turning the dipole from its stable to unstable equilibrium (back to back)

8. An electric dipole consists of ±1μC charges kept 10 cm apart. It lies in a uniform electric field of $5X10^4$ N/C at an angle θ with direction of electric field. If it experiences a torque of $2.5X10^{-3}$ Nm, Find
(a) Angle its axis makes with the field (E). **(b)** Potential energy of the dipole.
(c) Work done in turning it from its present position to the position of unstable equilibrium
(d) The position of the dipole in which the magnitude of the torque acting on the dipole becomes equal to its potential energy. **(e)** The maxi and min values of the potential energy of the dipole.

9. A molecule of a substance has permanent dipole moment equal to 10^{-29} Cm. A mole of this substance is polarized (at low temperature) by applying a strong electrostatic field of magnitude of 10^6 V/m. The direction of the field is suddenly changed by an angle of 60^0 .Estimate the heat released by the substance in aligning its dipoles along the new direction of the field. For simplicity, assume 100% polarization of the sample.

10. An electron falls downwards through a distance of 1.5cm in a uniform electric field of magnitude 2×10^4N/C (fig 1). The direction of the field is reversed keeping its magnitude unchanged and proton falls through the same distance (fig 2). Compute the time of fall in each case. Contrast the situation with that of free fall under gravity.

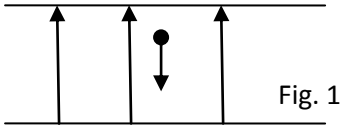


Fig. 1

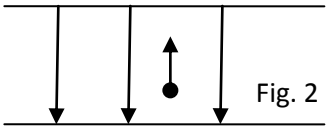


Fig. 2

11. A charged practical of mass 1.0 g is suspended through a silk thread of length 40 cm in a horizontal electric field of 4.0×10^4 N/C. if the practical stays at a distance of 24 cm from the wall in equilibrium; find the charge on the practical.

ANSWERS: **1.** (i) $3.38 X 10^6$ N/C,(ii) $.65 X 10^7$ N/C **2.** 2a from +q **3.** $4 X 10^7$ N/C **4.** $18 X 10^{-30}$Cm **5.** $8 X 10^{-3}$C, 8j **6.** 0,$7.5 X 10^{-8}$Cm **7.** (a) 10^{-7}Cm (b) $2.5 X 10^{-4}$j (c) $-4.33 X 10^{-4}$j (d) $-5 X 10^{-4}$j, $5 X 10^{-4}$j (e) $.67 X 10^{-4}$j (f) 10^{-3}j **8.** (a) 30^0 (b) $-4.33 X 10^{-3}$j (c) $8.66 X 10^{-3}$j (d) 135^0 (e) $5 X 10^{-3}$j,$-5 X 10^{-3}$j **9.** 3j **10.** $2.9 X 10^{-9}$s,$1.3 X 10^{-7}$s **11.** $1.8 X 10^{-7}$C