Numericals based on electric field

1. Two point charges +16μc and -9μc are placed 8cm apart in air . Determine the position of the point at which the resultant electric field is zero . Ans- 24 cm

2. A particle of mass m and charge q is thrown at speed u against a uniform electric field E . How much distance will it travel before coming to momentary rest . ? Ans- $mu^2/2qE$

3. A particle of mass m and charge q is released from rest in uniform electric field of intensity E . Calculate the kinetic energy it attains after moving a distance a distance x between the plates . Ans- qEx

4. Eight identical point charges of q coulomb each are placed at the corners of a cube of each side 0.1 m . calculate the electric field at the centre of the cube . calculate the field at the centre when one of the corner charge is removed . Ans – 0 ; 1.2×10^{12} .

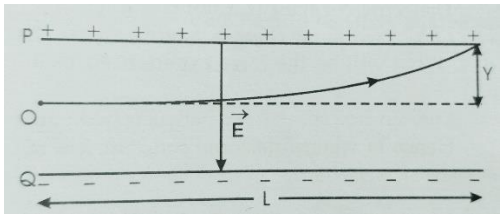
5. Two charges + 30μc and -30μc are placed 1cm apart . calculate electric field at a point on the the axial and equatorial line at a distance of 20 cm from the centre of the dipole . Ans- 6.25×10^5 N/C and $3,25 \times 10^{5-}$ N/C .

6. Four particles each of charge q are be placed on the vertices A ,B, C, D of a regular pentagon ABCDE . the distance of each corner from the centre is 'a' . Calculate the electric field at the centre of the pentagon . Ans- $q/4\prod\epsilon_0 a^2$ along OE .

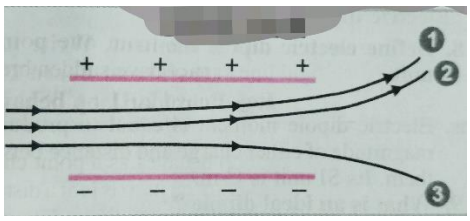
7. A small sphere of mass 1g carries a charge of +6μc . The sphere is suspended by a string in an electric field of 400N/C acting downwards. Calculate the tension in the string . What will be the tension if the charge on the sphere be -6μc . ANS- $1.22x\ 10^{-2}$ N . ; 74×10^{-4} N .

8. An electron falls through a distance of 1.5 cm in uniform electric field of value $2\ x10^4$N/C . when the direction of electric field is reversed , a proton falls through the same distance . compare the time of fall in each case .

9. A particle of mass 'm' and charge -q enters the region between two charged plates initially moving along x-axis with speed v_x (as shown in the fig) . The length of the plate is L and an 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 $QelL^2 / (2m\ v_x^2)$.



10. As shown in the figure three charged particles in a uniform electrostatic field . Give the sign of three charges . Which particle has the highest charge to mass ratio .



Numericals based on electric dipole (electric field at axial and equatorial point, torque and potential energy stored in dipole)-

1. Two charges + 30μc and -30μc are placed 1cm apart . calculate electric field at a point on the the axial and equatorial line at a distance of 20 cm from the centre of the dipole .

Ans- 6.25 x 10^5 N/C and 3,25 x 10^{5-} N/C .

2. An electric dipole of dipole moment 4 x 10^{-5} C-m is placed in uniform electric field of 10^3 N/C making an angle of 30^0 with the direction of field . Determine the torque exerted by the electric field on the dipole. Ans- 2 x 10^{-8}Nm .

3. An electric dipole is placed at an angle of 60^0 with an electric field of magnitude 4 x 10^5 N /C . It experience a torque of 8√3 Nm . If the length of the dipole is 2cm , determine the magnitude of either charge of the dipole . Ans - 2 x 10^{-3} C .

4. An electric dipole of length 10cm having charges of magnitude 6 x 10^{-3} C , placed at 30^0 with respect to a uniform electric field experience a torque of magnitude 6√3 N-m . Calculate (i) magnitude of the field and (ii) potential energy of the dipole . Ans- 2√3x 10^4; -18J

5. An electric dipole consist of two opposite charges of magnitude q=1x10^{-6}C separated by 2.0 cm . The dipole is placed in an external electric field of 1x10^5 N/C . What maximum torque does the field exert on the dipole ? How much work must an external agent to do turn the dipole end for end , starting from position of alignment (Θ=0^0) . Ans- 2x10^{-3} N-m ; 4x10^{-3}J .

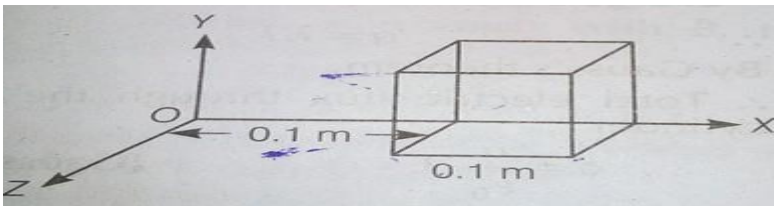
$$W = \int_{r1}^{r2} \frac{1}{4\prod\epsilon .} \frac{Qq}{r^2}$$

6. (i)Two point charges 4Q and Q are separated by 1m in air at what point on the line joining the two charges the electric field intensity is zero. (ii) Two identical metallic sphere A and B having charges +4Q and -10Q are kept at a certain distance apart . A third identical uncharged sphere C is first placed in contact with sphere A and then with sphere B . Spheres A and B are then brought in contact and then separated . Find the charges on the sphere A and B .

7.Calculate the amount of work done in turning an electric dipole of dipole moment 3x10^8 C-m from its position of unstable equilibrium to stable equilibrium, in a uniform electric field of intensity 10^3N/c.

8.The sum of two point charges is 7μc they repel each other with a force of 1N when kept 30 cm apart in free space , calculate the value of each charge.

9.(1)Define electric flux , write its SI unit . (2)The electric field components due to a charge inside the cube of side 0.1m are shown below $E_x=\alpha x$, where α =500N/C-m $E_Y=0, E_Z=0$



Calculate (a) The flux through the cube (b)the charge inside the cube

10. A uniformly charged conducting sphere of 2.5 m in diameter has a surface charge density of 100μC/m^2 . Calculate the (a) charge on the surface and (b)Total electric flux through the surface.

11. Two large, thin metal plates are parallel and close to each other. On their inner faces, the plates have surface charges densities of opposite signs and of magnitude 17.0 x 10^{-22} C/m^2. What is electric field strength E: (a) in the outer region of the first plate, (b) in the outer region of the second plate, and (c) between the plates?

12. (a) Two insulated charged copper spheres A and B have their centres separated by a distance of 50 cm. What is the mutual force of electrostatic repulsion if the charge on each is 6.5 x 10^{-7} C? The radii of A and B are negligible compared to the distance of separation.(b) What is the force of repulsion if each sphere is charged double the above amount, and the distance between them is halved?

13. A spherical conductor of radius 12 cm has a charge of 1.6 x 10^{-7} C distributed uniformly on its surface . What is the electric field (a) inside the sphere (b) on the surface of the sphere and (c) at a point 18 cm from the centre of the sphere ?

14. Find the ratio of gravitational and electrostatics force when electrons and protons are kept at some distance 'd' apart .

15. A tiny particle of mass 10μg is kept over a large horizontal sheet of charge density 4 x 10^{-6} C /m . What charge should be given to the particle so that if released it doesn't fall down ?