PYQ'S OF CHAPTER - 1
Electric charges and field
physics

Q1 Two identical charges, Q each, are kept at a distance r from each other. A third charge q is placed on the line joining the above two charges such that all the three charges are in equilibrium. what is the magnitude and sign of charge? Ans $q = \frac{Q}{4}$

Q2 Calculate Coulomb force between two α-particles separated by a distance of 3.2×10^{-15} m in air. Ans 90N

Q3 Calculate the distance between two protons such that the electrical repulsive force between them is equal to the weight of either. Ans 11.8 cm

Q4 Two identical metallic spheres, having unequal, opposite charges are placed at a distance 0.90 m apart in air. After bringing them in contact with each other, they are again placed at the same distance apart. Now the force of repulsion between them is 0.025 N. Calculate the final charge on each of them. Ans 1.5×10^{-6} C

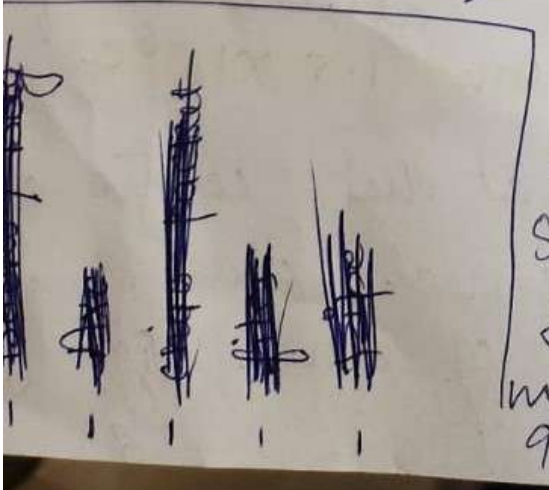
Q5 A charge q is placed at the centre of the line joining two equal charges Q. Show that the system of three charges will be in equilibrium if $q = -\frac{Q}{4}$

Q6 Two point electric charges of values q and 2q are kept at a distance d apart from each other in air. A third charge Q is to be kept along the same line in such a way that the net force acting on q and 2q is zero. Calculate the position of charge Q in terms of q and d. Ans $(\sqrt{2}-1)d$

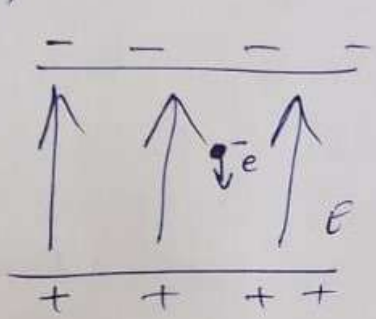
Calculate the voltage needed to balance an oil drop carrying 10 electrons when located b/w the plates of a capacitor which are 5mm apart. The mass of oil drop is 3×10^{-16} kg. Take $g = 10 m/s^2$ Ans 9.375 V

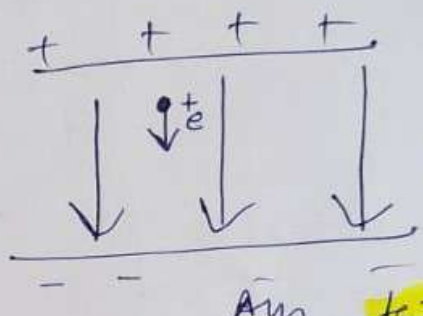
Q8 A simple pendulum consists of a small sphere of mass m suspended by a thread of length l. The sphere carries a positive charge q. The pendulum is placed in a uniform electric field of strength E directed vertically downwards. Find the period of oscillation of the pendulum due to the electrostatic force acting on the sphere Ans $T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{ml}{qE}}$

Q9 An ~~elec~~ electron moves a distance of 6cm when accelerated from rest by an electric field of strength 2×10^4 N/C. Calculate the time of travel. The mass and charge of e are 9×10^{-31} kg & 1.6×10^{-19} C.



Q10 An e^- falls through a distance of 1.5cm in a uniform electric field of magnitude 2×10^4 N/C. The direction of the field is reversed keeping its magnitude unchanged and a proton falls through the same distance. Compute the time of fall in each case. Contrast the situation (a) with that of 'free fall under gravity'





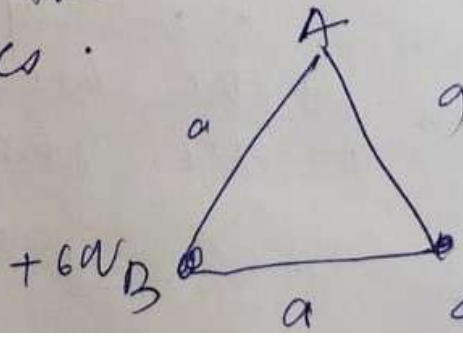
$t_p = 1.25 \times 10^{-5}$ s

Ans $t_e = 2.9 \times 10^{-9}$ s

Q11 Two point charges of +1μC and +4μC are kept 30cm apart. How far from the +1μC charge on the line joining the two charges, will the net electric field be zero?

Ans $x = 0.10$m or -0.30m

Q12 Two point charges $+6q$ and $-8q$ are placed at the vertices of 'B' and 'C' of an equilateral triangle ABC of side 'a' as shown in fig. Obtain the expression for (i) the magnitude and (ii) the direction of the resultant electric field at the vertex A due to these two charges.



Q13 Two charges, one +5μC and another -5μC are placed 1 mm apart. Calculate the dipole moment. Ans 5×10^{-9} cm

Q14 An electric field is uniform, and in the positive x direction for positive x and uniform with the same magnitude in the negative x direction for negative x. It is given that

$\vec{E} = 200\hat{i}$ N/C for $x > 0$

$\vec{E} = -200\hat{i}$ N/C for $x < 0$

and

A right circular cylinder of length 20 cm and radius 5 cm has its centre at the origin and its axis along the x-axis so that one face is at $x = +10$ cm and the other is at $x = -10$ cm.

+1.57 Nm²/C (i) what is the net outward flux through each flat face?

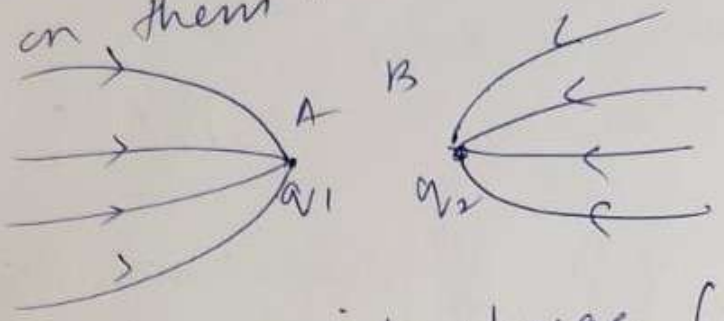
E=0 (ii) what is the flux through the side of the cylinder?

$\phi_E = 3.14$ Nm²/C (iii) what is the net outward flux through the cylinder?

$q = 2.78 \times 10^{-11}$ C (iv) what is the net charge inside the cylinder?

Q15 (a) An infinitely long positively charged wire has a linear charge density λ C/m. An e⁻ is revolving around the wire as its centre with a constant velocity in a circular plane perpendicular to the wire (b) plot a graph of the kinetic energy by q function of charge density λ.

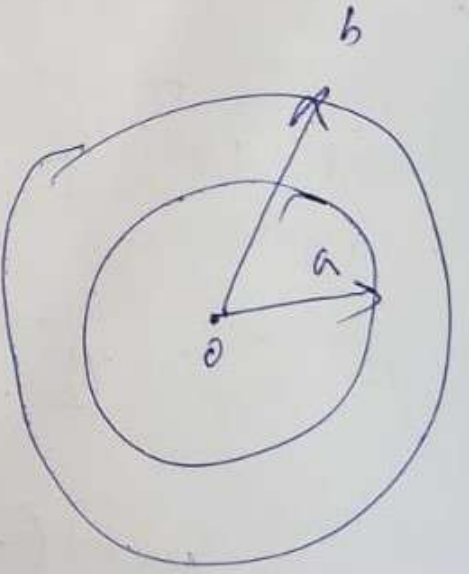
(2) fig shows electric lines of force due (3)
to point charges q_1 and q_2 placed at points A and B. work the nature of charge on them.



Q14 A positive point charge $(+Q)$ is kept in the vicinity of an uncharged conducting plate. Sketch electric field lines originating from the point charge on to the surface of the plate.

Q10 A point charge $+Q$ is placed at the centre O of an uncharged hollow spherical Conductor of inner radius 'a' and outer radius 'b'. find

a) The magnitude and sign of the charge induced on the inner and outer surface of the conducting shell.



b) The magnitude of electric field vector at distance (i) $r = \frac{a}{2}$ and (ii) $r = 2b$, from the centre of the shell.

Q19 An electric dipole free to move is placed in a uniform electric field. Explain along with diagram its motion when it is placed,
(a) parallel to the field
(b) perpendicular to the field.

Q20 An electric dipole of dipole moment $\vec{p}$ is placed in a uniform $\vec{E}$. Write the expression for the torque $\vec{\tau}$ experienced by the dipole. Identify two pairs of perpendicular vectors in the expression. Show diagrammatically the orientation of the dipole in the field for which the torque is (i) maximum (ii) half the maximum value (iii) zero.

Q21 A small metal sphere carrying charge $+Q$ is located at the centre of a spherical cavity in a large uncharged metal sphere as shown. Use gauss's theorem to find electric field at points P_1 and P_2.