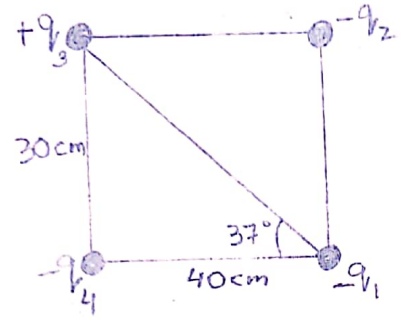
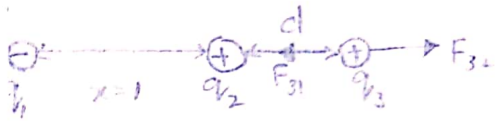
Electric Force

1. Find the net force on charge q 1 due to the three other charges in figure. Take q1= -5μC , q2 = -8 μC, q3 = 15 μC and q4 = - 16 μC. $(F = 2.3\hat{i} - 2.4\hat{j}\ N)$

Q.1

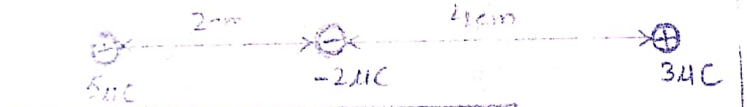


Q.2



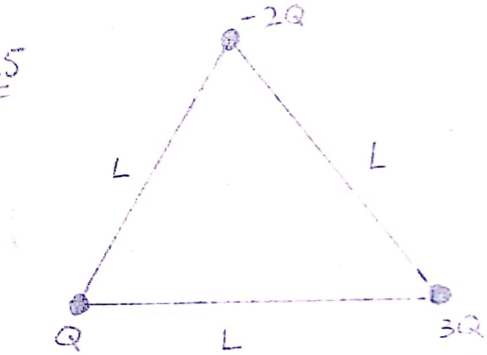
2. A point charge q1 = - 9 μC is at x=0 , while q2 = 4μC is at x=1 m. At what point, besides infinity, would the net force on a positive charge q3 be zero ? $(d = 2m)$
3. The electron and the proton in a hydrogen atom are 0.53 x 10-10 m apart. Compare the electrostatic and gravitational forces between them. $(F_E / F_G \Rightarrow ratio = 4.4 \times 10^{40})$
4. Three charges lie on a straight line, as shown in figure. Find the resultant force exerted on (a) the -2μC charge, (b) the 5μC charge.

Q.4



Ans : (a) -91 N (b) 133 N

Q.5



Ans : (a) $20.8\hat{j}$ N (b) $30\hat{i} - 27\hat{j}$ N

5. Three point charges are held at the corner of an equilateral triangle as shown is figure. Take Q = 2 μC and L = 3 cm. What is the resultant force exerted on the charge(a) 3Q and (b) -2Q ?
6. At what separation would the force between a proton and an electron be 1 N ? $(d = 1.52 \times 10^{-9}\ m)$
7. A point charge –Q is located at (0,-a) and a charge +Q is at (0 , a). Find the force on charge q at (x,0). (b) At what point is the force a maximum? $[(a) -2kQqa/(a^2 + x^2)^{3/2}\,\hat{j}\ ) (b)\ x = 0$
8. A proton orbits with a speed v = 294 km /s just outside a charged sphere of radius r = 1.13cm. Find the charged sphere. (e = 1.6×10^{-19}C and m = 1.67×10^{-27})

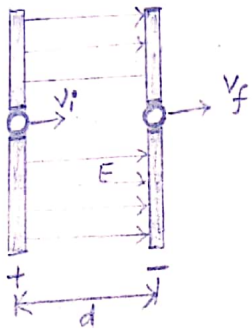
(Ans : 1.13×10^{-9} C)

$m_e = 9.1 \times 10^{-31}$ kg
$m_p = 1.67 \times 10^{-27}$ kg
$G = 6.67 \times 10^{-11}$

Electric Field

1. On a clear day there is an electric field of approximately 100N/C directed vertically down at the earth's surface. Compare the electrical and gravitational field on an electron. $\left(\frac{F_g}{F_E} = 5.6 \times 10^{-13}\right)$
2. A point charge Q1 =20 μC is at (-d, 0)while Q2 =-10 μC is at (+d,0). Find the resultant field strength at a point with coordinates (x, y). Take d= 1m and x=y=2m. $\left(E = 3.5 \times 10^{3}\hat{i} - 8.6 \times 10^{3}\hat{j}\ N/C\right)$
3. A proton travels a distance of a 4cm parallel to a uniform electric field E = 10^3 i N/C, as shown in figure. If its initial velocity is 10^5 m/s find its final velocity.

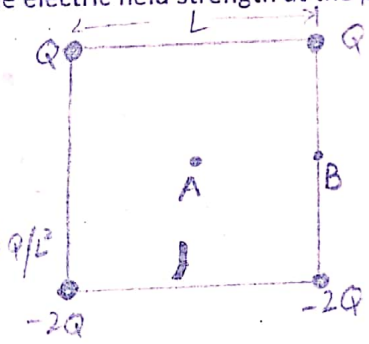
Q.3



Ans: $v_f = 1.3 \times 10^5$ m/s

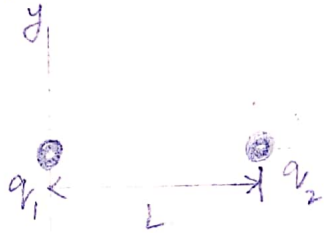
4. Four point charges are located at the corner of a square of side "L" as shown in figure. Find the electric field strength at the point (a) A and (b) B.

Q.4



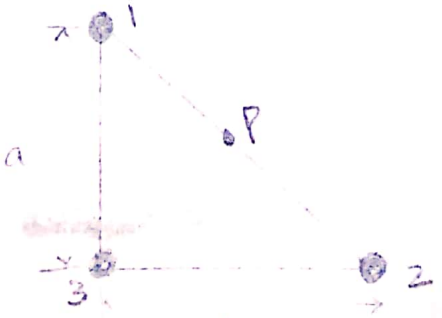
Ans: (a) $-2.7 \times 10^{9} q/L^2\,\hat{j}$
(b) $-4.1\hat{i} - 1.9\hat{j} \times 10^{9}\, q/L^2$

Q.5



5. In figure particle 1 of charge q1= -5q and particle 2 of charge q2 = +2q are fixed to an x axis. (a) As a multiple of distance L, at what coordinate on the axis is the net electric field of the particles is zero? (2.72 L)
6. What is the electric field strength needed to balanced the weight of the following particles near the Earth's surface :(a) an electron and (b) a proton. [(a) 5.58×10^{11} N/C (b) 1.02×10^{-7} N/C
7. What is the magnitude of a point charge that would create an electric filed of 1 N/C at a at point 1 m away ? [0.11×10^{-9} C]
8. Two particles are fixed to an x axis : particle 1 of charge -2x 10^{-7}C at x=6cm and particle 2 of charge +2 x 10^{-7}C at x = 21cm . Mid way between the particles, what is their net electric field in unit-vector notation? [$E = 6.29 \times 10^{5}$ N/C $\hat{i}$]
9. In figure the three particles are fixed in place and have charges q1 =q2 = +e and q3 = +2e. Distance a = 6 μm. What are the (a) magnitude and (b) direction of the net field at point "P" due the particles?

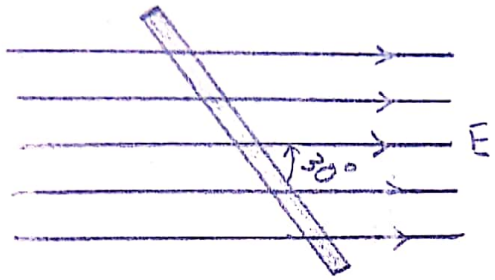
Q.9 :



Ans: (a) 160 N/C
(b) 45° counterclockwise from +ve x-axis

Gauss Law

1. A circular plate has a radius of 12 cm. The plane of the plate is set at a 30° angle to a uniform fields E= 450N/C, as shown in figure. What is the flux through the plate.



(Ans: $10.2\ N \cdot m^2/C$)

2. Two charges q1 = 6 μC and q2 = -8 μC are within a spherical surface of radius 5 cm. What is the total flux through the surface? [Ans: $-2.26 \times 10^5\ N \cdot m^2/C$ (inward)]

3. An isolated conductor of arbitrary shape carries a net charge +10 μC. Inside the conductor is a hollow cavity within which is a point charge q = +3 μC. What is the charge (a) on the cavity wall and (b) on the outer surface of the conductor? [(a) $-3\mu C$ (b) $13\mu C$]

4. A point charge of 1.8 μC is at the center of a cubical Gaussian surface 55cm on edge. What is the net flux through the surface? ($2.07 \times 10^5\ Nm^2/C$)

5. A uniform charged conducting sphere of 1.2 m diameter has a surface charge density of 8.1 μC /m2.(a) Find the net charge on the sphere (b) what is the total electric flux leaving the surface of the sphere? [(a) $3.7 \times 10^{-5} C$ (b) $4.10 \times 10^5\ Nm^2/C$]

6. An infinite line of charge produces a field of 4.52 x 104 N/C at a distance of 1.96m. Calculate the linear charge density.

7. A 60 μC charge is at the center of a cube of side 10 cm .(a) what is the total flux through the cube ?(b) What is the flux through the face ? (c) would your answers to (a) or (b) change if the charge were not at the center? [(a) $6.78 \times 10^6\ N \cdot m^2/C$ (b) $1.13 \times 10^6\ Nm^2/C$ (c) Yes for (b)]

8. A spherical conductor of radius 8cm has a uniform surface charge density 0.1 nC/m2. Find the electric field (a) at the surface (b) at a distance 10 cm from the center. [(a) $11.3\ N/C$ (b) $7.23\ N/C$]