Assignment 3: Chapter 21, Chapter 22 & Chapter 23

Deadline

Sunday, December 27th, 2020 … before 5:00 pm

Notes

1. Attempt all the questions given for each chapter in an A4 Size Paper.
2. Clear mention on the title page your assignment no.,Section, name and registration id.
3. Submit your assignments in Google Classroom by scanning your assignments in a single PDF using Cam scanner or MS Lens before the deadline.
4. Plagiarism will result in zero marks as well as black listing of the student.
5. You should verify your answers through the answer key which will be uploaded 2 days before the deadline.

Chapter 21: Electric Charge

P1.

Calculate Electric Force and Gravitational Force for each of the following situations;

a. A proton and neutron inside the nucleus. Comment on your findings.
b. Two protons in a nucleus; Comment on your findings.
c. An electron and proton in an atom. Compare the results with that of part b.
d. Two human beings, one standing at North Pole and the other at the South Pole. Assume that the mass of each person is 50 kg, and is carrying a net charge of 10^{-9} C.
e. Earth and Moon (assume charge on Earth = 3 C, and on Moon = -2 C). Which force is stronger and why?

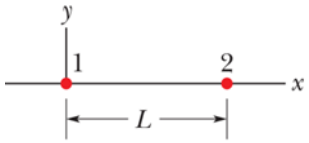
P2.

Which force (Electrostatic or Gravitational) is more dominant at

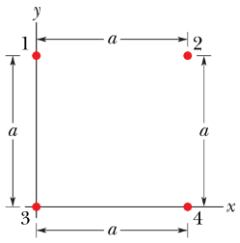
a. Nucleus level,
b. Atomic level
c. In our daily routines i.e. at earth
d. At solar system level

P3.

In Figure, particle 1 of charge +1.0 µC and particle 2 of charge -3.0 µC are held at separation L = 10.0 cm on an x-axis. If particle 3 of unknown charge q_3 is to be located such that the net electrostatic force on it from particles 1 and 2 is zero, what must be the (a) x and (b) y coordinates of particle 3?



P4.



In Figure shown, the particles have charges q1= q2 =100 nC and q3 = q4 =200 nC, and distance a = 5.0 cm. What are the (a) x and (b) y components of the net electrostatic force on particle 3?

P5.

Three point charges are located at the corners of an equilateral triangle, as shown in Figure -1 . Calculate the net electric force on the 7 μ C charge.

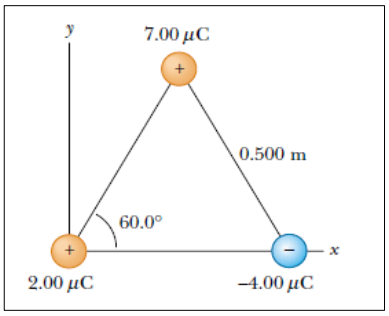


Figure 1

P6.

A point charge q_1 = - 9 μC is at x=0 , while q_2= 4μC is at x=1 m. At what point, besides infinity, would the net force on a positive charge q3 be zero?

P7.

At what separation would the force between a proton and an electron be 1 N ?

P8.

In Fig. 2a, particles 1 and 2 have charge 20.0 mC each and are held at separation distance d = 1.50 m. (a) What is the magnitude of the electrostatic force on particle 1 due to particle 2? In Fig2b Particle 3 of charge 20.0 mC is positioned so as to complete an equilateral triangle. (b) What is the magnitude of the net electrostatic force on particle 1 due to particles 2 and 3?

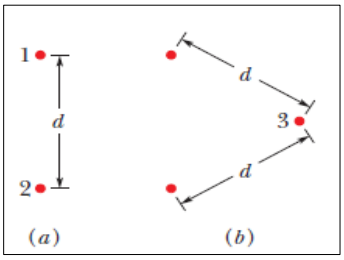


Figure 2

P9.

In figure-3 , particles 1 and 2 of chagre $q_1 = q_2 = +3.2 \times 10^{-19}$ C are on a y axis at distance d = 17cm from the origin. Particles 3 of chagre $q3 = + 6.4 \times 10^{-19}$ C is moved gradually along the x axis from x=0 to x=+5m. At what vlaues of x will the magnitude of the electrostatics force on the third particles from the other two particles be (a) minimum and (b) maximum?

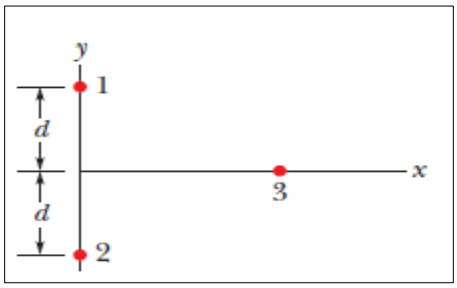


Figure 3

P10.

The electron and the proton in a hydrogen atom are 0.53×10^{-10} m apart. Compare the electrostatic and gravitational forces between them.

P11.

A proton orbits with a speed v = 294 km /s just outside a charged sphere of radius r = 1.13cm. Find the charged sphere. ($e = 1.6 \times 10^{-19}$C and $m = 1.67 \times 10^{-27}$)

P12.

Find the net force on charge q_1 due to the three other charges in figure 4. Take $q_1 = -5\mu C$, $q_2 = -8\ \mu C$, $q_3 = 15\ \mu C$ and $q_4 = -16\ \mu C$

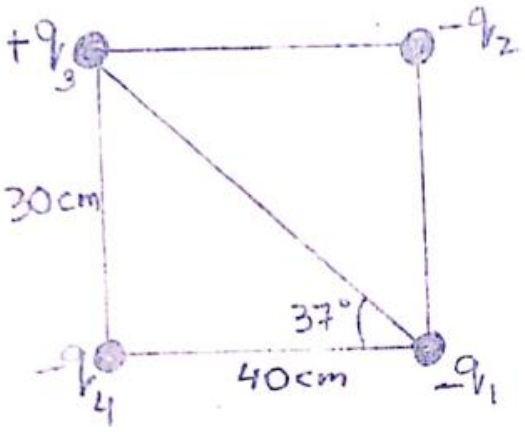


Figure 4

P13.

Three charges lie on a straight line as shown in Figure 5 . Find the resultant force on (a) the -2µC chage, (b) the 5µC charge.

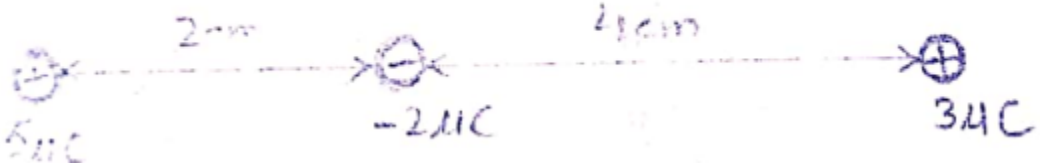


Figure 5

P14.

Three-point charges are held at the corner of an equilateral triangle as shown in Figure 6. Take Q= 2µC and L=3cm. What is the resultant force exerted on the charge (a) 3Q and (b) -2Q

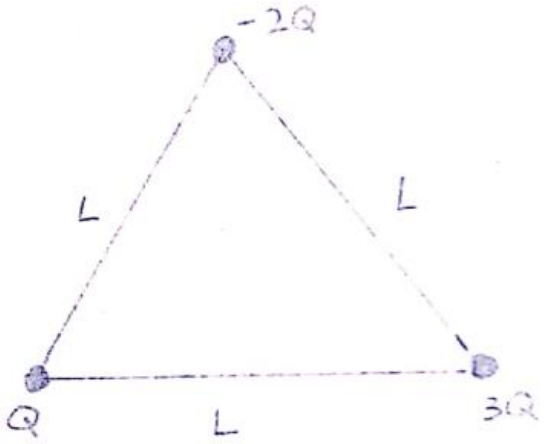


Figure 6

Chapter 22: Electric Field

P15.

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 forces on an electron.

P16.

A point charge Q_1 =20 µC is at (-d, 0) while Q_2 =-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.

P17.

A proton travels a distance of a 4cm parallel to a uniform electric field E= 10^3 i $\frac{N}{C}$ as shown in Figure 7. If its initial velocity is 10^5 m/s. Find its final velocity.

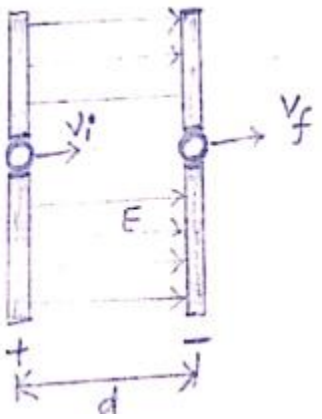


Figure 7

P18.

What is the magnitude of a point charge that would create an electric field of 1 N/C at a at point 1 m away?

P19.

Four point charges are located at the corner of a square of side "L" as shown in Figure 8. Find the electric field strength at the point (a) A and (b) B

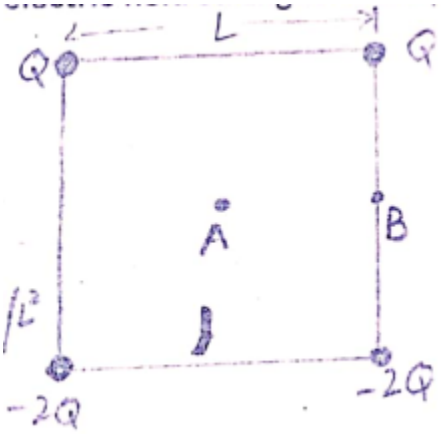


Figure 8

P20.

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?

P21.

In Figure 9 , particle 1 of charge $q_1 = -5q$ and particle 2 of charge $q_2 = +2q$ are fixed to an x-axis . As a multiple of distance L , at what coordinate on the axis is the net electric field of the particles is zero ?

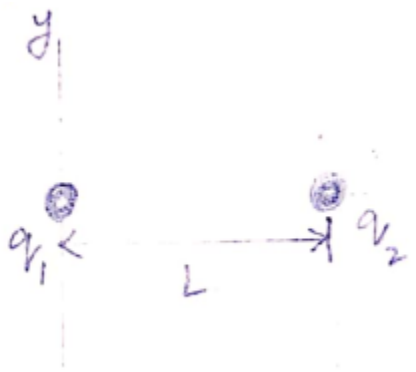


Figure 9

P22.

What is the electric field strength needed to balance the weight of the following particles near the Earth's surface :(a) an electron and (b) a proton.

P23.

In Figure 10 the three particles are fixed in place and have charges $q_1=q_2=+e$ and $q_3=+2e$. Distance a= 6µm . What are the (a) magnitude and (b) direction of the net field at point "P" due to the particles?

Figure 10

Chapter 23: Gauss' Law

P24.

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 11. What is the flux through the plate.

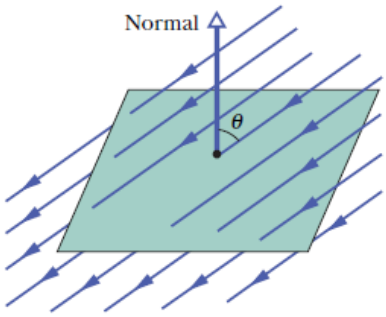


Figure 11

P25.

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?

P26.

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?

P27.

A point charge of 1.8 mC is at the center of a Gaussian cube 55 cm on edge. What is the net electric flux through the surface?

P28.

A uniform charged conducting sphere of 1.2 m diameter has a surface charge density of 8.1 µC /m^2.(a) Find the net charge on the sphere (b) what is the total electric flux leaving the surface of the sphere?

P29.

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.

P30.

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?

P31.

A spherical conductor of radius 8cm has a uniform surface charge density 0.1 nC/m^2. Find the electric field (a) at the surface (b) at a distance 10 cm from the center.