

Electric Charge and Electric Field

Assignment 2

Question 1

Two point charges q_1 and q_2 are located with points having position vectors \mathbf{r}_1 and \mathbf{r}_2 .

- (1) Find the position vector \mathbf{r}_3 where the third charge q_3 should be placed so that force acting on each of the three charges would be equal to zero.
- (2) Find the amount of charge q_3 .

Question 2

Consider a thin wire ring of radius R and carrying uniform charge density λ per unit length.

- (1) Find the magnitude of electric field strength on the axis of the ring as a function of distance x from its centre.
- (2) What would be the form of electric field function for $x \gg R$.
- (3) Find the magnitude of maximum strength of electric field.

Question 3

Two equally charged metal balls each of mass m Kg are suspended from the same point by two insulated threads of length l m long. At equilibrium, as a result of mutual separation between balls, balls are separated by x m. Determine the charge on each ball.

Question 4

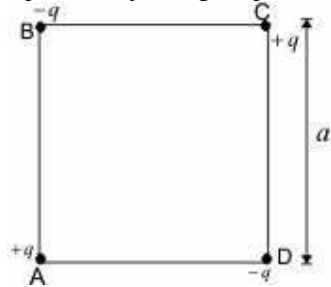
There are two identical particles each of mass m and carrying charge Q . Initially one of them is at rest and another charge moves with velocity v directly towards the particle at rest. Find the distance of closest approach.

Question 5

Find the electric field at the centre of uniformly charged semi circular arc having linear charge density λ .

Question 6

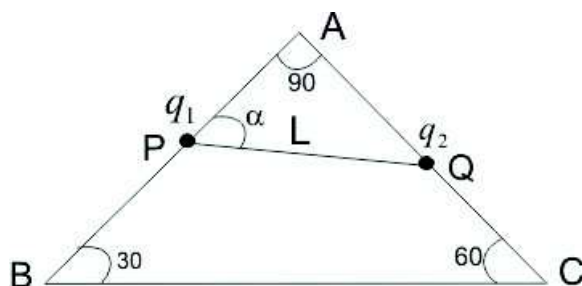
Two opposite corners of square carry charge $-q$ and other two opposite corners of same square carry charge $+q$ as shown below in the figure



All the four charges are equal in magnitude. Find the magnitude and direction of force on the charge on the upper right corner by the other three charges.

Question 7

A rigid insulated wire frame in form of a right angled triangle ABC is set in vertical plane as shown below in the figure.



Two beads of equal masses m and each carrying charges q_1 and q_2 are connected by a chord of length l and can slide without friction on the wires. Considering the case when beads are stationary determine

- (A) the normal reaction on the beads
- (B) the angle α
- (C) tension in the chord

If the chord is now cut what are the value of charges for which beads continue to remain stationary.

Question 8

Inside a ball charged uniformly with volume density ρ , there is a spherical cavity. The centre of cavity is displaced with respect to the centre of the ball by a distance a . Find the field strength inside the cavity assuming the permittivity to be equal to unity.

Question 9

An electric dipole is placed at a distance x from a infinitely long rod of linear charge density λ .

- (a) Find the net amount of force acting on the dipole.
- (b) Assuming that dipole is fixed at its centre find its time period of oscillations if the dipole is slightly rotated about its equilibrium position.