Assignment-3/Practice Sheet-3 : Coulomb's Law : Spring 2023

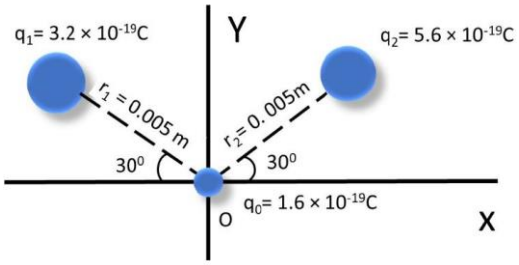
Course Code: PHY 2105/PHY 105

1. What must be the distance between point charge q_1 = 26.0 μC and point charge q_2 = 47.0 μC for the electrostatic force between them to have a magnitude of 5.70 N?

2. Two equally charged particles are held 3.2×10^{-3} m apart and then released from rest. The initial acceleration of the first particle is observed to be 7.0 m/s^2 and that of the second to be 9.0 m/s^2. If the mass of the first particle is 6.3×10^{-7} kg, what are (a) the mass of the second particle and (b) the magnitude of the charge of each particle?

3. A force $\vec{F}_1 = 3\hat{i} - 4\hat{j}$ is inclined at 60^o to the horizontal. (i) If the horizontal component of force is 40N, calculate the vertical component. (ii) If another force $\vec{F}_2 = -2\hat{i} + 3\hat{k}$ is acting with a new angle which is also inclined with horizontal axis, then find out the angle between $\vec{F}_1$ and $\vec{F}_2$.
4. The x component of a force vector is -25.0 m and the y component is +40.0 m. (a) What is the magnitude of the force vector? (b) What is the angle between the direction of and the positive direction of x?

5. Two forces act at a point in directions inclined to each other at 120°. If the bigger force is 5N and their resultant is at right angles to the smaller force, find the resultant and the smaller force.
6. Determine analytically the magnitude and direction of the resultant of the following four forces acting at a point. (i) 10 kN pull N 30° E; (ii) 20 kN push S 45° W; (iii) 5 kN push N 60° W; (iv) 15 kN push S 60° E.
7. Two small charged spheres repel each other with a force = 3×10^{-3} N. The charge on one sphere is twice that on the other. When one of the charges is moved 10 cm away from the other, the force = 5×10^{-4} N. Calculate the charges and the initial distance between them.
8. Four charges +2q, +4q, +2q and –2q are placed at the corners of a square. (i) Draw the arrangement of the charges (ii) Calculate the magnitude and direction of electrostatic forces on a charge -1q at the intersection of the diagonals of the square of side 10 cm if q = 3×10^{-9}C.
9. Consider the two protons are separated at a distance 5 nm from each other. Compare the electrostatic force and gravitational force between them. The gravitational constant is G = 6.6743×10^{-11} m^3 kg^{-1}s^{-2} and the mass of each proton is 1.67262192×10^{-27} kg.
10. From the figure, (a) Calculate the magnitude of net force on test charge q_0. (b) Calculate the direction of net force on test charge q_0.



11. What is the magnitude of the electrostatic force between a singly charged sodium ion (Na+, of charge +e) and an adjacent singly charged chlorine ion (Cl-, of charge -e) in a salt crystal if their separation is 3.81 × 10^{-7} m.
12. Point charge of + 8.0 μC and - 5.0 μC are placed on an x axis, at x = 8.0 m and x= 14 m. What charge must be placed at x = 26.0 m so that any test charge at x = 0 experience no electrostatic force?
13. How far apart must two protons be if the magnitude of the electrostatic force acting on either one due to the other is equal to the magnitude of gravitational force on a proton at Earth's surface?