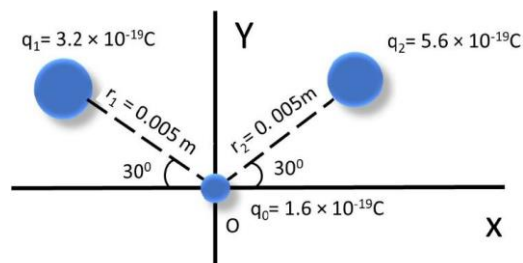


## Practice problem sheet Course: PHY 2105 Summer : 2024

### Title: Physics Content: Coulomb's Law

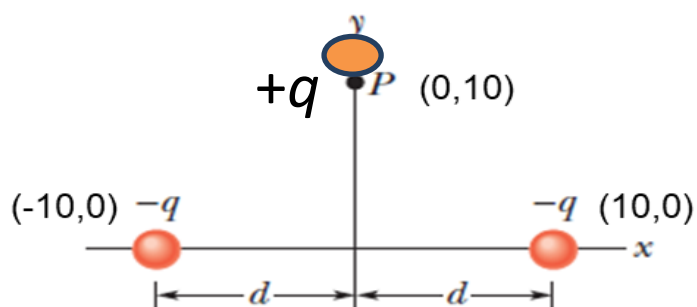
1. What is the net electric force at point  $q_1$  and the distance, if a distance  $r$  between point charge  $q_1 = 26.0 \mu\text{C}$  and point charge  $q_2 = -47.0 \mu\text{C}$  must be sustained for the electrostatic force between them to have a magnitude of  $5.70 \text{ N}$ ? Draw the direction of net force and express Coulomb force in vector? Which type of force it is attractive or repulsive?
2. Two equally charged particles are held  $3.2 \times 10^{-3} \text{ m}$  apart and then released from rest. The initial acceleration of the first particle is observed to be  $7.0 \text{ m/s}^2$  and that of the second to be  $9.0 \text{ m/s}^2$ . If the mass of the first particle is  $6.3 \times 10^{-7} \text{ kg}$ , what are (a) the mass of the second particle and (b) the magnitude of the charge of each particle?
3. The x component of a force vector is  $-25.0 \text{ m}$  and the y component is  $+40.0 \text{ m}$ . (a) What is the magnitude of the force vector? (b) What is the angle between the direction of and the positive direction of x?
4. Two forces act at a point in directions inclined to each other at  $120^\circ$ . If the bigger force is  $5 \text{ N}$  and their resultant is at right angles to the smaller force, find the resultant and the smaller force.
5. Two small charged spheres repel each other with a force  $= 3 \times 10^{-3} \text{ N}$ . The charge on one sphere is twice that on the other. When one of the charges is moved  $10 \text{ cm}$  away from the other, the force  $= 5 \times 10^{-4} \text{ N}$ . Calculate the charges and the initial distance between them.
6. 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  $10 \text{ cm}$  if  $q = 3 \times 10^{-9} \text{ C}$ .
7. Four charges are arranged in a square with sides of length  $2.5 \text{ cm}$ . The two charges in the top right and bottom left corners are  $+3.0 \times 10^{-6} \text{ C}$ . The charges in the other two corners are  $-3.0 \times 10^{-6} \text{ C}$ . What is the net force and direction exerted on the charge in the top right corner by the other three charges?
8. What is (i) the force between two  $4 \text{ gm}$  pennies  $2 \text{ m}$  apart if we remove all the electrons from the  $^{23}_{11}\text{Na}$  atoms? (ii) What is their acceleration as they separate?
9. Three charges lie on the x axis:  $q_1 = +25 \text{ nC}$  at the origin,  $q_2 = -12 \text{ nC}$  at  $x = 2 \text{ m}$ ,  $q_3 = +18 \text{ nC}$  at  $x = 3 \text{ m}$ . What is the net force on  $q_1$ ? and What is the direction?
10. Consider the two protons are separated at a distance  $5 \text{ nm}$  from each other. Compare the electrostatic force and gravitational force between them. The gravitational constant is  $G = 6.6743 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$  and the mass of each proton is  $1.67262192 \times 10^{-27} \text{ kg}$ .
11. Charges of magnitude  $100 \mu\text{C}$  each are located in vacuum at the corners A, B and C of an equilateral triangle measuring  $4 \text{ meters}$  on each side. If the charge at A and C are positive and the charge B negative, what is the magnitude and direction of the total force on the charge at B?
12. Charges of magnitude  $20 \text{ nC}$  each are located in vacuum at the corners A, B and C of a right angle triangle measuring  $5 \text{ m}$  in height and  $3 \text{ m}$  base BC. If the charge at A and C are positive and the charge B is negative, what is the magnitude and direction of the total force on the charge at A?

13. 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  $q_0$ .

14. What is the magnitude of the electrostatic force between a singly charged sodium ion ( $\text{Na}^+$ , of charge  $+e$ ) and an adjacent singly charged chlorine ion ( $\text{Cl}^-$ , of charge  $-e$ ) in a salt crystal if their separation is  $3.81 \times 10^{-7}$  m.
15. Two equal charges of  $10 \times 10^{-5}$  C are shown in fig below; each produces an electrostatic force at point  $P$  on  $y$  axis. (i) What is the magnitude of the force at  $P$ ? (ii) What is the direction of force?



16. Point charge of  $+8.0 \mu\text{C}$  and  $-5.0 \mu\text{C}$  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?
17. 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 gravity force on a proton at Earth's surface?
18. In Fig below, the particles have charges  $q_1 = -q_2 = 100$  nC and  $q_3 = -q_4 = 200$  nC, and distance  $a = 5.0$  cm. What are the (a)  $x$  and (b)  $y$  components of the net electrostatic force on particle 3?

