Homework #2, 4B

Donald Aingworth IV

January 29, 2025

Chapter 21, Problem 52

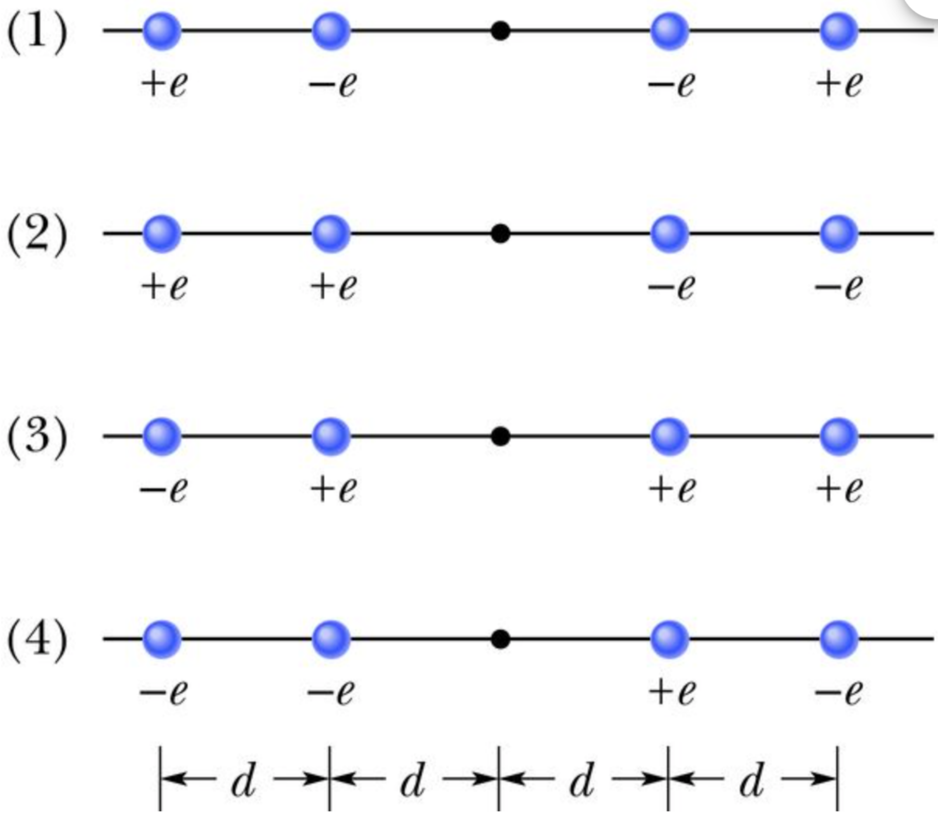
52 A particle of charge Q is fixed at the origin of an xy coordinate system. At $t = 0$ a particle ($m = 0.800$ g, $q = 4.00\ \mu$C) is located on the x axis at $x = 20.0$ cm, moving with a speed of 50.0 m/s in the positive y direction. For what value of Q will the moving particle execute circular motion? (Neglect the gravitational force on the particle.)

Chapter 21, Problem 66

66 An electron is in a vacuum near Earth's surface and located at $y = 0$ on a vertical y axis. At what value of y should a second electron be placed such that its electrostatic force on the first electron balances the gravitational force on the first electron?

Chapter 22, Question 4

4 Figure 22-25 shows four situations in which four charged particles are evenly spaced to the left and right of a central point. The charge values are indicated. Rank the situations according to the magnitude of the net electric field at the central point, greatest first.



Chapter 22, Question 5

5 Figure 22-26 shows two charged particles fixed in place on an axis. (a) Where on the axis (other than at an infinite distance) is there a point at which their net electric field is zero: between the charges, to their left, or to their right? (b) Is there a point of zero net electric field anywhere *off* the axis (other than at an infinite distance)?

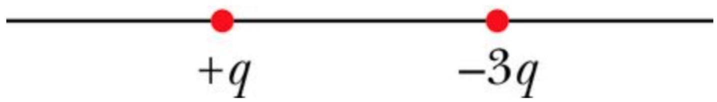


Figure 22-26 Question 5.

Chapter 22, Problem 8

••8 In Fig. 22-36, the four particles are fixed in place and have charges $q_1 = q_2 = +5e$, $q_3 = +3e$, and $q_4 = -12e$. Distance $d = 5.0\ \mu\text{m}$. What is the magnitude of the net electric field at point P due to the particles?

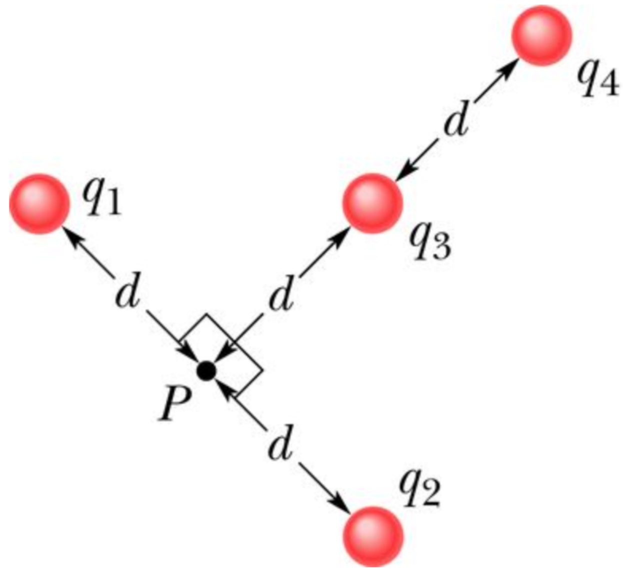


Figure 22-36 Problem 8.

Chapter 22, Problem 12

••12 GO Figure 22-39 shows an uneven arrangement of electrons (e) and protons (p) on a circular arc of radius r = 2.00 cm, with angles θ_1 = 30.0°, θ_2 = 50.0°, θ_3 = 30.0°, and θ_4 = 20.0°. What are the (a) magnitude and (b) direction (relative to the positive direction of the x axis) of the net electric field produced at the center of the arc?

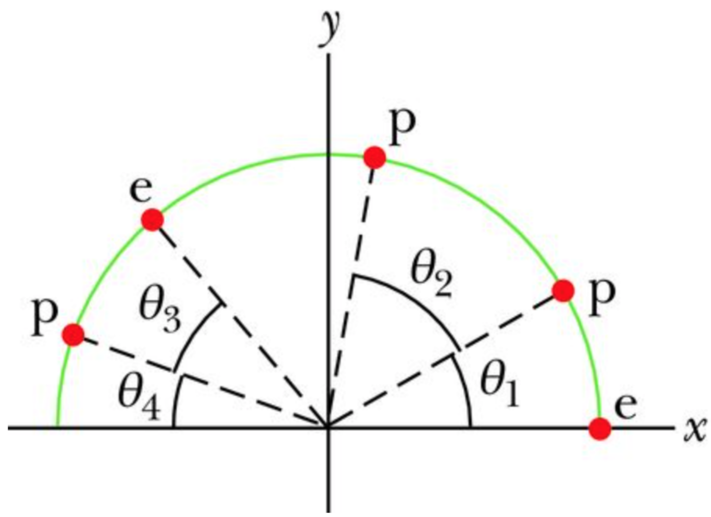


Figure 22-39 Problem 12.

Chapter 22, Problem 46

•46 An electron is accelerated eastward at 1.80×10^9 m/s^2 by an electric field. Determine the field (a) magnitude and (b) direction.

Solution

The formula we have from Newton's second law is $\vec{F}_{net} = m\vec{a}$. We already have the acceleration, that being $1.80 \times 10^9 \text{m/s}^2$ eastward. We can also apply the mass of the electron ($9.1093837 \times 10^{-31}$kg), also keeping in mind the charge of an electron ($-1.60217663 \times 10^{-19}$C). We can also keep in mind that $\vec{F}_{net} = q\vec{E}_{net}$

$$\begin{aligned}\vec{F}_{net} &= m\vec{a} = q\vec{E}_{net} \\ \vec{E}_{net} &= \frac{m\vec{a}}{q} = \frac{(9.1093837 \times 10^{-31}\text{kg}) * (1.80 \times 10^9 \text{m/s}^2)}{-1.60217663 \times 10^{-19}\text{C}} \\ &= -1.02341342103 \times 10^{-2}\text{N/C}\end{aligned}$$

a) Since we are looking for the magnitude, we take the absolute value, which is (approximately) $\boxed{1.0234 \times 10^{-2}\text{N/C}}$.

b) Since the original charge was going eastward and the electric field is in the opposite direction, the direction is $\boxed{\text{westward}}$.