Homework 22.3

The nucleus of a plutonium 239 atom contains 94 protons. Assume that the nucleus is a sphere with a radius 6.64 fm and with the charge of the protons uniformly spread through the sphere. At the surface of the nucleus, what are the

a. magnitude and

b. direction (radially inward or outward)

of the electric field produced by the protons?

a) $E = \frac{q}{4\pi \epsilon_0 r^2} = \frac{94 \times 1.6 \times 10^{-19}}{4\pi\, 8.854 \times 10^{-12} \times 6.64^2 \times 10^{-30}}$

$= \frac{94 \times 1.609}{4\pi\, 8.854 \times 6.64^2} \times 10^{-19+12+30}$

a) $E = 3.08 \times 10^{21}$ N/C

b) OUT ward.

Homework 22.5

A charged particle produces an electric field with a magnitude of 2.0 N/C at a point that is 50 cm away from the particle. What is the magnitude of the particle's charge?

$$E = \frac{q}{4\pi\epsilon_0 r^2}$$

$$q = E * 4\pi\epsilon_0 r^2$$

$$= 2 * 4\pi\, 8.854\times10^{-12} \times 0.5^2$$

$$q = 55.6\times10^{-12}\ C$$

$$= 56\ pC$$

Homework 22.9

Figure 22-37 shows two charged particles on an x axis: - q = - 3.20 x 10^{-19} C at x = - 3.00 m and q = 3.20 x 10^{-19} C at x = + 3.00 m. What are the

a. magnitude

b. direction (relative to the positive direction of the x axis)

of the electric field produced at point P at y = 4.00 m?

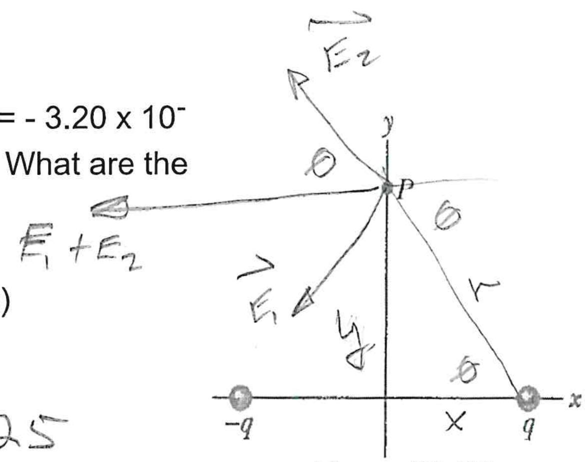
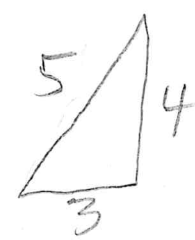


Figure 22-37

$$r^2 = x^2 + y^2 = 3^2 + 4^2 = 25$$

$$\cos\theta = \frac{x}{r} = \frac{3}{5} = 0.6$$



By symmetry the Electric Field will only have an x component.

$$\vec{E} = 2E_x \hat{x}$$

$$E = 2E_x = \frac{2q\cos\theta}{4\pi\epsilon_0 r^2}$$

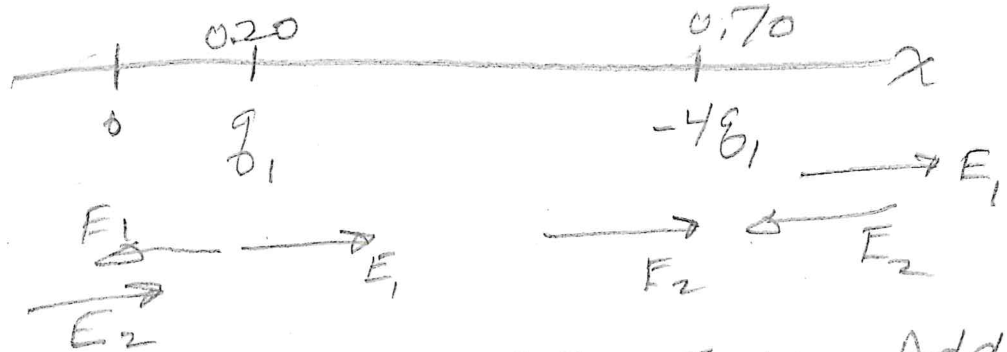
$$E = \frac{2 \times 3.2 \times 10^{-19} \times 0.6}{4\pi\ 8.854 \times 10^{-12}\ 25} = 0.00138 \times 10^{-7}$$

a) $\vec{E} = -1.38 \times 10^{-10}\ \hat{x}$ N/C

b) $-\hat{x}$ 180° relative to the x axis

Homework 22.11

Two charged particles are fixed to an x axis: Particle 1 of charge $q_1 = 2.1 \times 10^{-8}$C is at position x = 20 cm and particle 2 of charge $q_2 = -4.00q_1$ is at position x = 70 cm. At what coordinate on the axis (other than infinity) is the net electric field produced by the two particles equal to zero?



For $0.2 < x < 0.7$ Fields Add

For $x > 0.7$ fields subtract but E_2 is much Larger than E_1

∴ Fields add to zero at a point $x < 0.20$ m

$$\frac{q_2}{q_1} = -4$$

$$\frac{q_1}{4\pi\epsilon_0 r_1^2} - \frac{4q_1}{4\pi\epsilon_0 r_2^2} = 0$$

$$\frac{r_2^2}{r_1^2} = 4$$

$$\left(\frac{x-0.7}{x-0.2}\right)^2 = 4$$

$$\frac{x-0.7}{x-0.2} = 2$$

$$x - 0.7 = 2(x-0.2)$$

$$-x = 0.7 - 0.4 = 0.3$$

$$x = -0.3$$

$$x = -30 \text{ cm}$$

Homework 22.27

In Fig 22-51 two curved plastic rods, one of charge + *q* and the other of charge - *q*, form a circle of radius R = 8.50 cm in an xy plane. The x axis passes through both of the connecting points, and the charge is distributed uniformly on both rods. If *q* = *15.0 pC*,, what are the

a. magnitude and

b. direction (relative to the positive direction of the x axis) of the electric field **E** produced at P, the center of the circle?

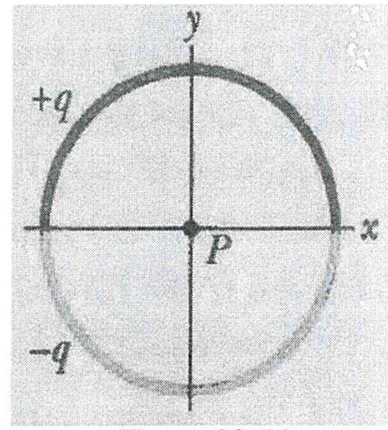
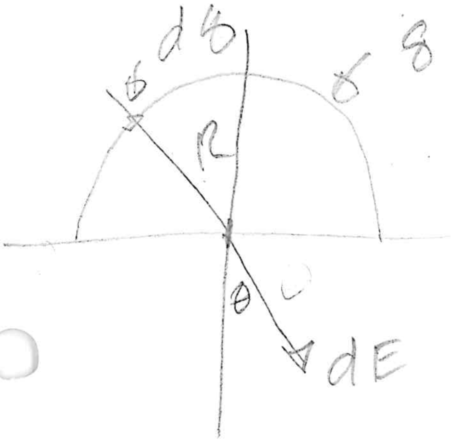


Figure 22-51

Similar To Prob 22.03 page 641



$dq = \lambda R\, d\theta$

$dE_y = \dfrac{2\, dq \cos\theta}{4\pi\epsilon_0 R^2}$

$= \dfrac{2 Q R \cos\theta\, d\theta}{\pi R 4\pi\epsilon_0 R^2}$

$= \dfrac{2 \times 15 \times 10^{-12} \cos\theta\, d\theta}{4\pi^2\, 8.854 \times 10^{-12} (0.085)^2}$

$dE_y = 2\, dE \cos\theta$

$= \dfrac{dq\, 2\cos\theta}{4\pi\epsilon_0 R^2}$

$\lambda = \dfrac{q}{\pi R}$

$\int_{-\pi/2}^{\pi/2} \cos\theta = 2$

The fields from the two Semi Circular Rings add.

Magnitude $E_y = \dfrac{15}{\pi^2 \times 8.854 \times (0.085)^2}$

$E_y = 23.2\ N/C$

direction is down y

$\theta = -90°$