Ch 22 HW Assignment: Answers & HW Hints (Pt. 1)

Part 1: Intro to E-Field

Pg. 598-599 #1, 3, 5-7, 9-11

Answers

1a. 6.4×10^{-18} N

b. 20

3. 5.6×10^{-11} C

5a. 3.1×10^{21} N/C

b. Outward

6. -639,289i N/C

7. x=-30cm

9. +101,710j N/C

10. $E_{net} = 0$ N/C

11a. 1.38×10^{-10} N/C

b. 180°

Ch 22 #5

A couple little points:

1. **Since the charge is said to be distributed uniformly throughout the nucleus, the electric field behaves just as if the entire charge was located at the center of the nucleus.**
2. **“fm” just means femtometers, and the prefix femto- means x10^{-15}. (You can always find any unknown prefixes in a table at the front of your book.)**

Ch 22 #7

Remember that, even though maybe you haven't practice a "Net E-field = 0" kind of problem, you previously learned how to do "Net Force = 0" problems. This one should be VERY similar to those old problems from Ch 21.

Ch 22 #9

Hopefully you were able to gather that this is one of those problems where you find the individual E-field vectors due to all of the individual particles, and then use vector addition ideas to find the net electric field. However, this is definitely one where you can make life a little easier on yourself by looking at symmetry, after you've found the four E-field vectors. (Notice in the answer that there's no x-component to the net E-field. You should be able to see this pretty easily once you've got all four of them.)

Ch 22 #10

Since you can tell all of the individual E-field vectors will be along the two perpendicular axes, it's definitely easiest to just rotate the entire figure to our standard x- and y-directions.

Then make sure your work includes some sort of explanation for why zero is the correct answer.

Ch 22 HW Assignment: Answers & HW Hints (Pt. 2)

Part 2: ‘Special’ Charge Distributions

Pg. 600-601 #19, 22a, 24, 25, 27a-c, 29

Answers

19a. kqd/r^3

b. -90^o from +x-axis

22a. $1.7x10^{-15}$ C/m

24a. 20.6 N/C

b. -90^o from +x-axis

25a. 23.76 N/C

b. -90^o from +x-axis

27a. $-5.19x10^{-14}$ C/m

b. 0.00157 N/C

c. in -x direction

29a. $1.62x10^6$ N/C

b. -45^o from +x-axis

Ch 22 #19

You should see that the x-components of the vectors will cancel, so that the net E-field is just based on the y-components of the two vectors. To find the y-components, you would obviously use sinθ, but this might seem hard because you don't know θ. But it actually turns out that you don't need it, because you can just think of sinθ as meaning opp/hyp. The opposite side is just d/2, and the hypotenuse can be found with the Pythagorean theorem. Once you have your expression with d's in it, then think about what can magically disappear because r>>d.

Ch 22 #24

Think about an E-field vector from the top half of the semicircle, and a symmetric vector from the bottom half. The 2 x-components will cancel and the net E-field only depends on the y-components. So set up your expression for each differential part of E_y, based on differential parts of θ. Then integrate over the top half of the semicircle and multiply your answer by 2 (to account for the effects of the bottom half).

Ch 22 #25

This one should work very similarly to #24. In fact, symmetry allows you to still just integrate over ¼ of the circle, and then multiply your answer by 4 to account for the other parts. One important difference about this one compared to #24, though, is when you calculate the linear charge density. The charge that you're told isn't spread over just ¼ of the circle, but is instead spread over ½ of it.

Ch 22 #27

Each point along the rod contributes a little differential bit of left-directed E-field to the total E-field at point P. So start by finding an expression for the differential parts of E, based on differential parts of the rod's length (dx). For this expression, realize that the distance from each dx to point P is a different distance, given by (0.12+x). Once you have your expression, integrate over the entire length of the rod. For help with the integration itself, go on to the next page.

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Ch 22 #27 (cont.)

You should be performing the following integral (with the exception of some constants)…

$$\int_0^L \frac{1}{(0.12+x)^2}\,dx$$

This integration can be done with u-substitution, if you make u=(0.12+x). Then du/dx = 1 and you're really just integrating $\int \frac{1}{u^2}\,du$

After you've done the relatively easy integration with u, go back and re-substitute, and evaluate at the two limits.

Ch 22 #29

The symmetry of this one is easier to deal with if you rotate the entire figure so it's symmetric about the y-axis. Once you've done this, you need to do 3 separate integrals to find the 3 separate E-fields. Each integral should be with respect to θ, with limits from 0 to 45° (and then double each answer). Make sure you pay attention to which E-field component cancels, and which one doubles, though.

Lastly, combine all 3 of the E-fields by either adding or subtracting, depending on direction. (But they're all along the same axis, right?)

Ch 22 HW Assignment: Answers & HW Hints (Pt. 3)

Part 3: Point Charges in E-Fields

Pg. 602 #39, 40, 42, 45, 48

Answers

39. 3.51×10^{15} m/s^2

40a. 0.01 N/C

b. to West

42a. 2.04×10^{-7} N/C

b. upward

45a. 1.92×10^{12} m/s^2

b. 1.96×10^{5} m/s

48a. $(-2.11 \times 10^{13}$ j) m/s^2

b. $(1.5 \times 10^{5}$ i – 2.81×10^{6} j) m/s

Ch 22 #48

For part A, just remember that forces only cause acceleration in the same direction as the force.

For part B, treat the x- and y-components of motion separately, since the object is only accelerating in the y-direction. You ultimately need to calculate both of the final velocity components (to be able to write final velocity in unit-vector notation), but you'll need to use some thinking similar to projectiles to find those velocities. (Use x-dir constant vel to find time, then use that time in y-dir kinematic equations.)