

Ch 24 HW Assignment: Answers & HW Hints (Pt. 1)

Part 1: Intro to Electric Potential

Pg. 647-648 #2, 3b, 4-6, 7a, 9, 8a, 11a

Answers

2. $1.2 \times 10^9 \text{ eV}$

3b. $3,628,000 \text{ J}$

4a. $+2.46 \text{ V}$

b. $+2.46 \text{ V}$

c. 0 V

5. 0.0089 m

6a. $24,375 \text{ V/m}$

b. 2925 V

7a. $1.87 \times 10^{-21} \text{ J}$

9. -32 V

8a. $+30 \text{ V}$

11a. $2.68 \times 10^{-4} \text{ V}$

Ch 24 #3b

You obviously can't make much progress on part B without the answer from part A. So here ya go...

$$3a. \quad Q = 302,400 \text{ C}$$

Ch 24 #8a

You're hopefully able to do this one by figuring out an expression for the variable E-field as a function of x . Then you can of course integrate from 0 to $2m$. (You won't get the answer from the integral, because the integral tells you *change in* potential. To find final potential, you need to add your answer to the initial value of $+10V$.)

But, since you're using a graph to get your info, and since you're calculating an integral, you could also of course just crank this one out by considering the area between the curve and the x -axis.

Ch 24 #11a

This one's a little rough... You're going to have to find V as the integral of $E \cdot dr$, so you need to start by finding an expression for E . Use Gauss' law for this one, remembering that only some of the Q_{total} is enclosed inside your Gaussian surface. You should wind up with an expression that looks like this...

$$E = \frac{qr}{4\pi\epsilon_0 R^3}$$

(Be sure to show how you arrived at this expression, though.)

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Ch 24 #11a (cont.)

Once you've got the expression for E-field, the hard work's done. Now just integrate the expression with respect to "r", which means that everything except for "r" can be moved out in front of the integral. Evaluate over the given interval, and you're done!

Ch 24 HW Assignment: Answers & HW Hints (Pt. 2)

Part 2: Potential Due to Point Charges and Uniform Charge Distributions

**Pg. 648-649 #12, 13, 15, 17, 19, 23, 25b,
26, 31, 32a**

Answers

12a. -4495 V

b. -4495 V

13a. 3.34 nC

b. $1.18 \times 10^{-8} \text{ C/m}^2$

15. $5.62 \times 10^{-4} \text{ V}$

17a. 6 cm

b. -12 cm

19a. $5.394 \times 10^{-4} \text{ m}$

b. 793.7 V

23a. -2.30 V

b. -1.78 V

25b. 0

26. 37,145 V

31. 13,485 V

32a. 35.96 V

Ch 24 #17

For this one, you'll need to use some thinking similar to (but not quite identical to) equilibrium problems for electric forces and fields. The idea is that the net potential will only equal zero at a location that the two different contributions to the net potential (from q_1 and q_2) add up to equal zero. The difference between this one and an E-field one, for instance, is that E-field is a vector and potential is not. So you don't have to consider direction of V , but you do still have to consider general regions where V could possibly equal zero.

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Ch 24 #17 (cont.)

Hopefully it makes sense, based on the formula $V = kq/r$, that these two potential values could only ever add to equal zero at a location closer to the smaller charge. But there are actually two locations where this would happen, one on the $+x$ axis between the charges, and one on the $-x$ axis. So set up two separate equations, setting $V_1 = -V_2$ in each one, and thinking about what the distances from each charge to the location are, for a $+x$ location and then for a $-x$ location.

Ch 24 #19

Part A should be a piece of cake. Part B's a little bit more fun, though. Give some thought to what happens when the two drops combine. Would the radius of the resulting drop be twice as large as the original drop's? No, silly. But the volume of the resulting drop would definitely be twice as large. See if you can use that thinking to lead you in good directions.

Ch 24 #26

I hope that you didn't need help with this one.
But just in case...

To find potential due to the sphere, you would just need to know charge of the sphere and distance from its center to the location of this point in space. So use Gauss' law to easily calculate the charge of the sphere, and then you should be good.

Ch 24 #32a

This one is a little different, because it's a non-uniform charge distribution. So to find V , you can't just use kq/r . But you can find V with this integral...

$$V = \int dV = \int \frac{k dq}{r} = \int_0^{0.2\text{m}} \frac{k \lambda dr}{r}$$

You should be good now, as long as you substitute the λ value they gave you, and do the integral right.

Ch 24 HW Assignment: Answers & HW Hints (Pt. 3)

Part 3: Calculating Field from Potential

Pg. 650 #34-37, 39

Answers

34a. 39 V/m

b. Toward, because...

35. $(-12 \hat{i} + 12 \hat{j})$ V/m

36. 667 V/m

37. $(-4E^{-16} \hat{i} + 1.6E^{-16} \hat{j})$ N

39. 150.1 V/m

Ch 24 #37

Remember, the E-field is just found by $E = -dV/dr$. So if you're using a graph, you should be able to just find the negative slope of the line to find the E-field. (Or at least one particular direction's component of the E-field.)

So after you've found both E-field components, it shouldn't be too rough to find the two force components.

Ch 24 #39

Just like the example in class, remember that you can switch from i, j, k notation to magnitude notation with the Pythagorean theorem. Unlike the example from class, there are three directions to the E-field. But Pyth thm is still easy even in three dimensions...

$$\mathbf{E} = \sqrt{\mathbf{E}_x^2 + \mathbf{E}_y^2 + \mathbf{E}_z^2}$$

Ch 24 HW Assignment: Answers & HW Hints (Pt. 4)

Part 4: Electric Potential Energy

Pg. 650-651 #41, 44, 45, 47-49, 53

Answers

41. $-1.92 \times 10^{-13} \text{ J}$

44a. $1.15 \times 10^{-19} \text{ J}$

b. Decreases, because...

45a. $5.99 \times 10^4 \text{ V}$

b. $-7.79 \times 10^5 \text{ V}$

c. 2.52 V

d. Increases, because...

e. Same, because...

f. Same, because...

47. 2479 m/s

48. $1.79 \times 10^{-10} \text{ J}$

49. $22,478 \text{ m/s}$

53. 318 m/s

Ch 24 #41

Just remember the general idea practiced in class, that work is however much work is required to assemble the system from infinity. So just add the work needed to bring in the 1st charge (0J), plus the work required to bring the 2nd charge from infinity (which is only based on V due to 1st charge), plus the work needed to bring in the 3rd charge (which is based on two potential values), and lastly plus the work needed to bring in the 4th charge (which is based on all three other potential values). Have fun!

Ch 24 #48

Don't fret about the fact that the charge is distributed on a ring instead of at one location. Because you're being asked to move another charge around on the ring's central axis, remember that the symmetry makes this problem pretty simple. The moving charge, at its final location, is 1.5m from all of the ring's charge. At its initial location, it is also equidistant from all charge on the ring (though you need to find that distance).

Ch 24 HW Assignment: Answers & HW Hints (Pt. 5)

Part 5: Potential and Conductors

Pg. 652 #62-64

Answers

62. +400 V, because...

63. 2.5×10^{-8} C

64a. Equal, because...

b. $q/3$

c. $2q/3$

d. 2

Ch 24 #64

The big deal on this one is just to realize that when the two spheres are connected by a wire, charge is going to flow (because the electrons want to repel one another as far as possible). But charge doesn't necessarily flow until both spheres reach the same charge. Instead, charge flows until they reach the same potential. This is because the spheres & wire essentially become one big equipotential surface when connected.

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Ch 24 #64 (cont.)

So parts B and C should become clear once you know that $V_1 = V_2$. For part D, you just need to compare their surface charge densities, which are calculated by charge/area. So use your answers to parts B and C, along with their different radii (and therefore different surface areas) to find the ratio asked for in part D.