PHYS 122: Guidelines and Examples for Doing Homework Problems

January 14, 2008

Most students in the class have already some experience with solving physics problems. However, there is a wide range of student ideas as to what constitutes a good homework submission.

In an effort curb what might be called "bad habits" right from the start, I am including here a set *homework guidelines* plus a set of **three example problems** that might have been included in the first homework, plus my own hand-written solutions that look very similar to the way I would expect student's work to look like. Please check these out *before* you start work on the first homework.

Important Homework Guide:

1. . Rule Number One: **The Right Answer is worth nothing!** That's right. Zero points. Nada. This is true on homework, it is true on exams. If you simple write the final correct answer, all by itself with no explanation of the physics concept where this answer comes from, then the graders are instructed to give zero credit for such an answer.

2. Same as Rule Number One: **You must show your work. You must explain your answer.** Such an explanation need not be long sentences or paragraphs. Typically a simple sketch or diagram, along with a few short sentence fragments or some simple labels are sufficient. If you introduce new symbols, you need some words to define them. If you use an equation, you need to label it so that we know that you what this means. Your solutions cannot be just "pure math" – there needs to be at least a few English words in there so that the grader can tell that you know what you are doing and why you are doing it.

3. Same as Rule Number One: At the start of each problem (or at the start of each major part of a multi-part problem) you need to clearly state which **major physics concept** is being applied to solve the given problem. For example, if you are going to use Coulomb's Law to solve a problem, you need to write down the law mathematically and then also put down the words "Coulomb's Law".

4. **Explain your work.** Remember the key rule of Physics 122 grading: **The correct answer alone is worth nothing.** You *must* explain what you are doing at least a little bit. Do not simply start a problem by writing down an equation and solving it. This is inadequate for both homeworks and exams. Even two or three words or a little sketch makes all of the difference.

5. **Important: Neatness counts.** Illegible or very-difficult-to-read work will simply be graded wrong. Your work must be cleanly and clearly organized so that the grader can follow your logic. Sloppy work will be down-graded. If this is a problem for you, consider writing up your solutions on a computer instead of by hand.

6. Write down the source of any formulae or equations you might use and tell us why you chose to use them – e.g., is there a guiding principle or concept? Please do not pull equations out of "thin air". It is very important that you and the grader have a clear picture of where these come from. Again, only a few words will do it. For example if you use Coulomb's Law, write down words something like "Coulomb's Law" on your homework next to the equation.

7. Keep your work *neat, organized, and coherant*. There needs to be a "logical flow" to your work so that the grader can see each step of your work from beginning to end. Do not jump around the page. Also *avoid crowding your work.* I realize that many students write small but small writing and/or crowded work makes the job of grading very hard. Leave lots of white space so that the grade can see what you are doing and can make helpful comments. As a rule *do not put more than one problem per paper sheet*. I always "start fresh" on a new sheet of paper for every problem. This way, if I get stuck on a given problem I can go to the next one and then put everything together neatly into one final assignment.

8. As a rule, **work out the solution to every problem in terms of symbolic algebraic variables *before* you plug in numerical values.** In my opinion this plugging in numbers too soon is a really common bad habit and for this course we will grade to discourage it strongly. Unless the problem is a simple units conversion or something like this you must *always* solve the problem symbolically (with variables such as q and t and θ, before you plug in any numbers for any values. Always solve *first* in terms of symbolic (variables) algebra. Always plug in the numbers as the *very last step*. (The one exception to this rule is that you can always plug in the number "zero"). This is preferable for many reasons, not the least of which it is guaranteed to please the grader and earn you more points.

9. If you are asked to produce a graph or a plot, please take the time to do this *carefully and neatly!* Unless you are told otherwise, if you are given data, you are expected to *use graph paper* to make a plot. Alternately, using computer plotting packages for neatness is encouraged. If you draw a plot by "hand", please be sure to put proper axis labels and scale. Be neat and complete!

10. Use the correct physical units. Do not report that the electric field has a value of 4.53 – report that the field is 4.53 Newtons per Coulomb. Unless clearly indicated otherwise in a problem, only use SI units (meters, seconds, kilogram, coulombs, newtons, amps, ohms, volts, joules, watts, etc.)

11. Please write "Physics 122 Homework #01" or something like this at the top of the first sheet. Please **neatly** write your full name on the top sheet, as it appears in your university registration. Please also **very neatly** write your shorthand case "Network Id" (something like "kxk32") on your homework at the top. It's a good idea also to also put this on the top of each sheet of paper, and to label your pages, something line "page 1", "page 2", etc. This *really* helps with record keeping and in case something gets misplaced.

12. **Your work must be stapled.** Buy a stapler. You will lose points if your work is not stapled. I'm not kidding here.

13. Please hand in your homework on $8\frac{1}{2} \times 11$ sheets (or approximately this size). You may use lined or un-lined paper. Your paper must be neat.

14. Use a dark pencil, blue pen, or black pen. Avoid red pen or felt tips. No smudges or smears, please. Do not make big erasing marks. If you feel the need to remove something from the submitted, please neatly cross out the work you want us to disregard.

15. Report your answer with an *appropriate* number of significant digits. Many students use way too many significant digits. This is a bad habit and I will ask graders to consider taking off points points in the future. If I state a problem with only two or three significant digits for the given values, then it makes no sense to use numbers with 8 significant digits in your answers. The extra precision is not justified and you are really just wasting alot of effort and pencil pushing for no good reason. Note: don't get hung up on significant digits. All I care is that you get the number of digits *approximately* correct. If the answer requires four significant digits and you put down 3, or 5, or even 6 digits then this is fine. Just don't put down 8 digits.

16. A personal peeve: Please use proper exponential notation, not "computer-speak". In other words when the number in decimal is 123.0 you can write this as 1.23×10^2 but please do not write 1.23E2. Doing so will cause the graders to cringe.

17. Your final answer for each problem should have a nice neat **box drawn around it** and should ideally be in the form of a sentence is possible. This applies to *both* your final *symbolic* answer and (if appicable) your final *numerical* answer.

18. Please represent vectors using physics notation. Something like $\vec{A} = A_x\hat{i} + A_j\hat{j}$ for example. Do not represent vectors using the "bracket" notation $< 324.33, 2342.11 >$ or like this.

An Example Homework Problem and Solutions:

Example Problem: Three point particles each with charge 20 nC are fixed in position on a straight line with a separation of 5.0 centimeters from particle to particle. What is the net force (magnitude and direction) on the third particle?

Example Problem

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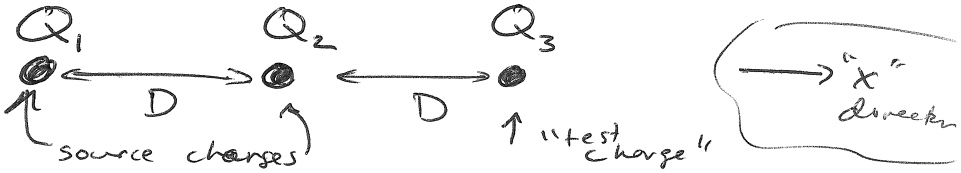

→ 3 point charges in a line

→ Each has charge $Q_1 = Q_2 = Q_3 = Q = 20\,\mu C$

→ Separation $D = 5\,cm = 0.05$ meters

Plan

Step 1 Calculate E-field

Step 2 Determine force on Q_3 due to that Field.

← **Superposition**

$$\vec{E}_3 = \vec{E}_{31} + \vec{E}_{32}$$

↑ net field at (3) ↑ field due to charge (1) ↑ field due to charge (2)

$$\vec{E}_{31} = \frac{k Q_1}{r_{13}^2}\hat{r}$$

← "Coulomb's law"

$$= \frac{k Q_1}{(2D)^2}\hat{i} = \frac{kQ}{4D^2}\hat{i}$$

$$\vec{E}_{21} = \frac{k Q_2}{r_{12}^2}\hat{r} = \frac{kQ}{D^2}\hat{i}$$

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Therefore: $\vec{E}_3 = \vec{E}_{31} + \vec{E}_{21}$

$= \frac{kQ}{4D^2}\hat{\imath} + \frac{kQ}{D^2}\hat{\imath}$

$\vec{E}_3 = \frac{5}{4}\frac{kQ}{D^2}\hat{\imath}$ ← Field at (3) result of STEP 1

$\vec{F}_{Q3} = Q_3\vec{E}_3 = Q\vec{E}_3$

$\vec{F}_{Q3} = \frac{5}{4}\frac{kQ^2}{D^2}\hat{\imath}$

Point to the right.

Plugging in number

$\vec{F}_{Q3} = \frac{\left(\frac{5}{4}\right)\left(9\times10^9\ N\cdot m^2/C^2\right)\left(2.0\times10^{-6}\ C\right)^2}{(0.05\ m)^2}$

$\vec{F}_{Q3} = (18\ \text{Newtons})\,\hat{\imath}$