Name_____

University of Maryland
Department of Physics

Physics 122 **Dr. E. F. Redish**
Spring 2010 **Exam 2 (Makeup)** **22. April. 2010**

Instructions:

Do not open this examination until the proctor tells you to begin.

1. When the proctor tells you to begin, **write your full name at the top of every page.** This is essential since this exam booklet will be separated for grading.
2. Do your work for each problem on the page for that problem. You might find it convenient to either do your scratch work on the back of the page before starting to write out your answer or to continue your answer on the back. **If part of your answer is on the back, be sure to check the box on the bottom of the page so the grader knows to look on the back!**
3. On all the problems *except the multiple choice questions in problem 1 or where it says not to explain*, your answers will be evaluated at least in part on how you got them. More than half the credit of the problem may be given for the explanation. YOU MAY EARN LITTLE OR NO CREDIT FOR YOUR ANSWERS IF YOU DO NOT SHOW HOW YOU GOT THEM. Partial credit will be granted for correct steps shown, even if the final answer is wrong. Explanations don't need to be long, but they need to show what physics you are using and assumptions you are making.
4. Write clearly and logically so we can understand what you are doing and can give you as much partial credit as you deserve. We cannot give credit for what you are thinking — only for what you show on your paper.
5. If you try one approach and then decide on another, cross out the one you have decided is wrong. If your paper contains both correct and incorrect approaches the grader will not choose between the two. You will not receive any credit when contradictory statements are present, even if one is correct.
6. All calculations should be done to the appropriate number of significant figures.
7. At the end of the exam, write and sign the honor pledge in the space below ("I pledge on my honor that I have not given or received any unauthorized assistance on this exam."):

You may find some of the following numbers useful in this exam (or not):

3.141592	3.0×10^8 m/s	330 m/s	6×10^9
9×10^9 N-m^2/C^2	$\frac{2}{3} \times 10^{-10}$ N-m^2/kg^2	$2/\pi \times 10^7$ m	3×10^8

#1:	#2:	#3:	#4:	#5:	Total

****** Good Luck ******

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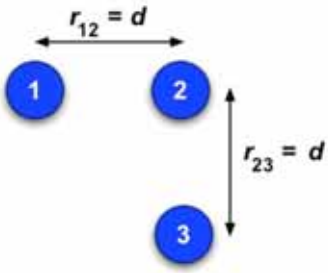
Spring 2010 **Exam 2 (M.U.)**

1. (25 points) In the figure at the right are shown three charges. The distance between charge 2 and 3 is the same as the distance between charges 1 and 2 and the angle between the line connecting their centers is a right angle. The magnitude of the electric force that 1 exerts on 2 is F_0. Put your answers to each of the questions below in the boxes at the right. Do any work in the spaces provided, but for this question only answers will be evaluated. No explanations are required. (5 pts each)



For the next three problems express your answers as a multiple of F_0. Assume all three charges are equal and positive unless told otherwise.

A. The magnitude of the force charge 3 exerts on charge 1 is

B. The magnitude of the net force on charge 2 is

C. If the magnitude of charge 2 is doubled while the other charges remain the same, the magnitude of the net force on charge 2 becomes

For the next two items, put the symbol corresponding to the correct completion for the sentence in the box at the right.

D. In the situation in C, the electric field measured by charge 2 is greater than (>), the same as (=), less than (<) the electric field it measures in situation B.

E. In the situation in C, the electric field measured by charge 1 is greater than (>), the same as (=), less than (<) the electric field it measures in situation B.

If you need more space, continue on the back and check here.

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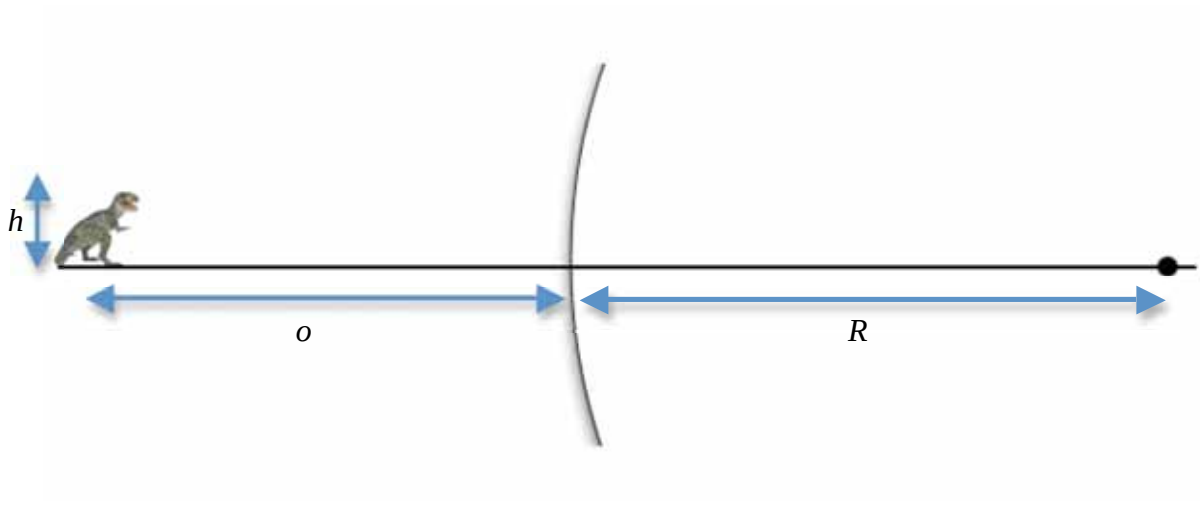
2. (25 points) In the movie Jurassic Park, a car is being chased by a T-Rex and it is shown in the car's passenger side external mirror – the one that says, "objects in mirror are closer than they appear." (See figure at the right.) Let's analyze whether this is really true.

A. In the figure below is shown a mirror curved like the outside passenger-side mirror of a car. The mirror is cut from part of a sphere whose radius is *R*. The center of this sphere is marked by a circular dot at the far right. An object is a distance *o* from the mirror, as shown. On the figure, draw a careful ray diagram and indicate on your diagram the distances that correspond to the distance of the image from the mirror (*i*) and the image size (*h'*). (10 pts)



B. If the radius of the mirror is 2 meters and the T-Rex is 10 meters from the mirror and stands 5 meters tall (the ray diagram is not to scale), how big is the image and how far is it from the mirror? Put your answers in the box and show your reasoning in the space below. (10 pts)

h' =
i =

C. Did you find that the image is bigger or smaller than the original object? Is it farther from the mirror than the object or closer? (Circle the correct relations in the box at the right.) Does your result support or contradict the statement on the mirror? (5 pts)

$h' > h$	$h' = h$	$h' < h$
$i > o$	$i = o$	$i < o$

If you need more space, continue on the back and check here. ☐

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3. (15 points) A current trend is for people to put solar panels on their roof and generate their own electricity. A typical solar house is shown at the right. If the average power delivered at the surface of the earth when the sun is shining is 1 W/m^2, estimate the total amount of energy (in kiloWatt-hours) that could be generated in the US if every house had solar panels. *Be sure to clearly state your assumptions and how you came to the numbers you estimated, since grading on this problem will be mostly based on your reasoning, not on your answer.*

If you need more space, continue on the back and check here. ☐

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4. (10 points) In our study of optics, we began with obvious foothold ideas from everyday life and came up with the ray model. This was very successful in many ways, but it failed to describe interference phenomena. To describe interference, we introduced a very different model of light: the wave model. Discuss whether you think there is a value to having these different models and to what extent you are able to reconcile them in your thinking about light. Be specific and use examples where appropriate. *Note: This is an essay question. Your answer will be judged not solely on its correctness, but for its depth, coherence, and clarity.*

If you need more space, continue on the back and check here. ☐

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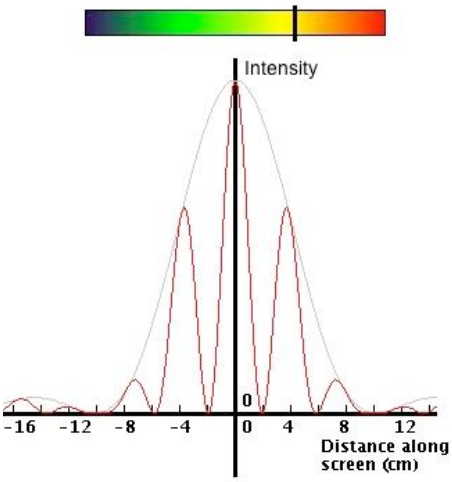
5. (25 points) A laser of the color marked on the spectrum (wavelength = 600 nm) is put through two slits and produces an intensity pattern on the screen that is represented by the graph at the right (red line).



A. If the slits are known to have a separation of 0.25 mm, can you infer the distance between the slits and the screen? If so, find it. If not, explain what information you would need in order to find it. (8 pts)

B. From the intensity pattern shown, can you infer whether the slits have the same width or not? If you can, tell whether they do or not and explain how you know. If you can't, explain what information you would need in order to decide. (5 pts)

C. Can you find the width of the slits from the information you have? If you can, find them. If you can't explain what information you would need to find them. (7 pts)

D. If the screen were moved closer to the slits, what would happen to the graph of the pattern on the screen? (5 pts)

If you need more space, continue on the back and check here. ☐