Name____

University of Maryland
Department of Physics

Physics 122		**Dr. E. F. Redish**
Spring 2011	**Exam 1 (Make Up)**	**10. March. 2011**

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."):

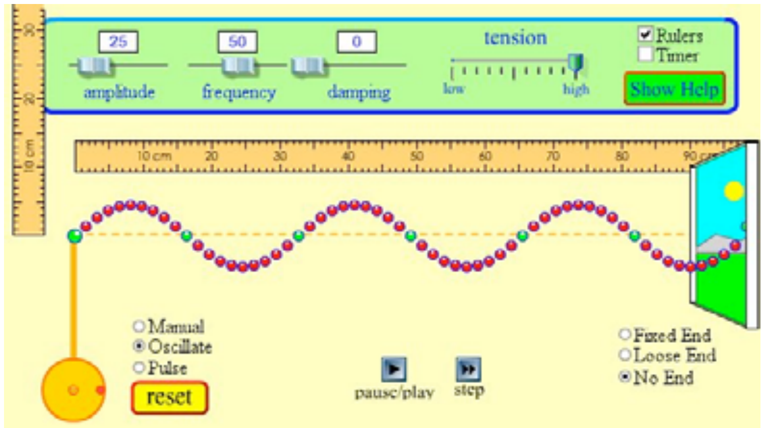
#1:	#2:	#3:	#4:	#5:	Total

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

NAME____ **POINTS**_______

Physics 122 **Dr. E. F. Redish**
Spring 2011 **Exam 1 (M.U.)**

1. (25 points) A simulation program models a machine that generates a wave on a beaded string. A rotating yellow disk attached to a rod drives the green bead attached to it in an up-down motion proportional to $\sin(\omega_0 t)$. A screen from the program is shown at the right. The rulers give the scales for x and y axes with the 0 of the two axes taken at the position of the green bead attached to the yellow rod at the instant shown. Take $t = 0$ to be the instant shown.



For each of the items below, select which of the answers could be correct. If more than one answer is correct, give them all. If none are correct, write N.

1.1 When the play button is pressed, the wave pattern shown in the picture begins to move to the right. Given everything we are told, what could be the correct equation for the position of the green bead attached to the yellow rod in this case?

A. $y(t) = \sin(\omega_0 t)$
B. $y(t) = (5\,\text{cm})\sin(\omega_0 t)$
C. $y(t) = (5\,\text{cm})\cos(\omega_0 t)$
D. $y(t) = -(5\,\text{cm})\sin(\omega_0 t)$
E. Something else.

1.2/1.3 The tension shown is set at its maximum. If I slide the tension slider down to halfway between low and high what will happen to the wavelength and the speed with which the wave pattern moves down the string?

A. It will increase.
B. It will decrease.
C. It will not change.
D. You can't tell from the information given.

Wavelength	Speed

1.4/1.5 I go back to the original screen. Instead of changing the tension I now change the driving frequency to half the value shown. What will happen to the wavelength and speed of the wave pattern?

A. It will increase.
B. It will decrease.
C. It will not change.
D. You can't tell from the information given.

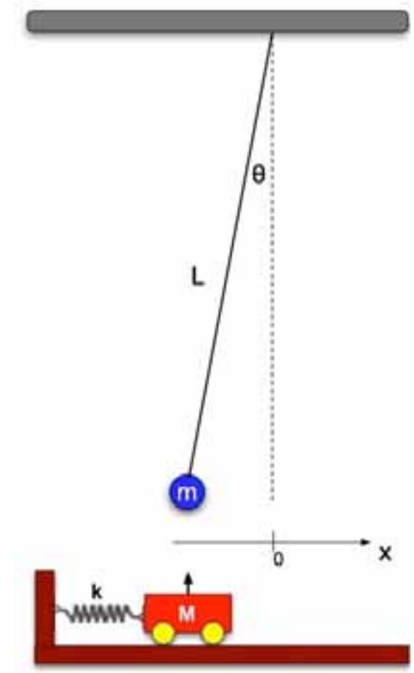
Wavelength	Speed

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

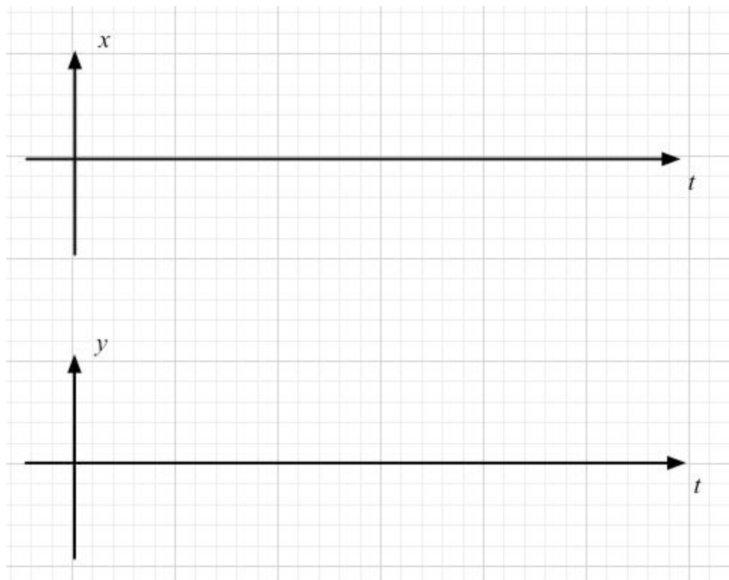
NAME____ POINTS_______

Physics 122 **Dr. E. F. Redish**
Spring 2011 **Exam 1 (M.U.)**

2. (25 points) A long pendulum that only swings through a small angle has a horizontal displacement that is very similar to a mass on a spring. If the pendulum at the right and the cart were started together, they would oscillate back and forth so that they had the same value of their x-coordinate as a function of time. We expect that both of them will oscillate with a function that looks something like "cos($\omega_0 t$)" where ω_0 is a constant that is characteristic of the physical system.



A. (10 pts) Sketch graphs for the x and y position of the <u>pendulum</u> assuming that the position at $t = 0$ is as shown in the figure with $\theta = 10^o$. (This means that you can ignore the up-down motion for the x-graph, but not for the y! Don't worry about the vertical scales.)



B. (8 pts) Since harmonic oscillation is about forces (pulling back to an equilibrium point) and inertia (keeping going through the equilibrium point), we expect the ω_0 for the mass and spring should depend on the mass of the cart, M, and the spring constant k. Construct an equation for ω_0 as a function of those parameters and give an explanation to justify why you constructed it the way you did.

$\omega_0 =$

C. (7 pts) Suppose the cart oscillates with a period of 1.6 s and we want the pendulum to oscillate with the same period. If the pendulum bob has a mass of 400 grams, how long should we make the string? Explain your reasoning.

$L =$

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

NAME____ **POINTS**_______

Physics 122 **Dr. E. F. Redish**
Spring 2011 **Exam 1 (M.U.)**

3. (15 points) Flash drives these days seem very small to those of us who were around at the beginning of the personal computer revolution. The hand shown in the picture at the right is holding a drive that can store 32 GigaBytes (32 x 10^9 Bytes). Estimate how big a Byte is; that is, how much physical volume in the drive has to be devoted to storing the information in 1 Byte? *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.

NAME____ **POINTS**_______

Physics 122 **Dr. E. F. Redish**
Spring 2011 **Exam 1 (M.U.)**

4. (10 points) Two of the "icons" I use in this class are (1) "Foothold ideas" – basic principles that we trust and reason with (at least for a while), and (2) "The implication game" – using our principles to draw conclusions with multi-step thinking. Sometimes putting these two together leads to surprising results that turn out to be true. Pick one example of some result we reasoned out that surprised you. Explain what you expected, what happened, and how you dealt with the conflict. Did you just say, "Oh, I was wrong," or did you attempt to reconcile your expectations with the results we found? If you were able to reconcile, explain how. If not, explain why not. (If you had no problem you might describe another student you interacted with had and how you helped them resolve their problem.) *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. ☐

NAME______________________________________ POINTS_______

Physics 122 **Dr. E. F. Redish**
Spring 2011 **Exam 1 (M.U.)**

5. (25 points) Alice is in Looking-Glass House (having passed through the mirror in Lewis Carroll's *Alice Through the Looking Glass*) and is being visited by her friend Aslan, from Narnia.

A. (10 pts) They are standing in front of the mirror (a few feet away) and it is of a size that Alice discovers that when she is standing next to Aslan, her image just all fits in the mirror – the top of her head appears at the top of the mirror and her feet are just visible at the bottom. But she can only see 2/3 of Aslan. (She is 4 feet tall, while he is 6.) How tall is the mirror? Draw a careful ray diagram to demonstrate your reasoning.

h =

B. (10 pts) If she steps back to twice the distance, she finds that her feet still are just visible at the bottom of the mirror. Does she see the top of her head in the mirror? If so, where? Explain your reasoning.

C. (5 pts) If Aslan has stayed where he was when she stepped back, will she now be able to see more of him or less? Explain your reasoning with a ray diagram.

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