Name_____

University of Maryland
Department of Physics

Physics 122 **Dr. E. F. Redish**
Spring 2010 **Exam 1** **5. March. 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. You may lose credit for giving too many.
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 ******

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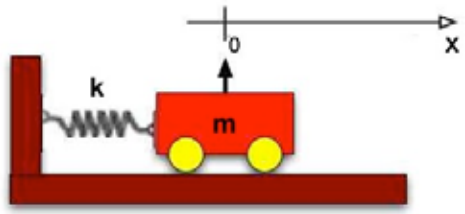
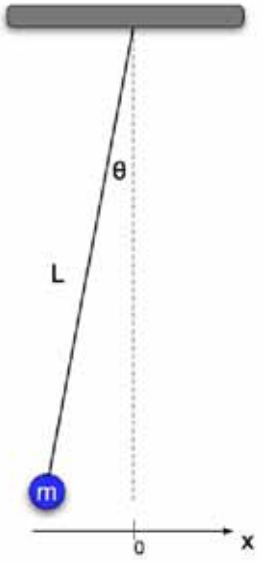
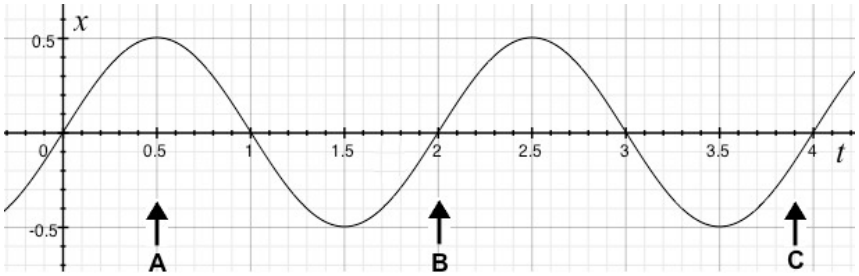
1. (30 points) In the figures at the right are shown two systems: a cart moving back and forth on a spring and a swinging pendulum. The graph below can be used to show the back and forth displacement of both systems as a function of time as long as the pendulum is kept at a small angle.







A. Three instants of time are marked on the graph: A, B, and C. Complete the table below by indicating the direction of the quantity for the two cases using one of the following symbols: L (Left), R (Right), U (Up), D (Down), 0 (Zero), or S (Some other direction – draw an arrow to indicate which). (3 each)

	Cart	Pendulum
Velocity at A		
Velocity at C		
Acceleration at B		
Net force on m at B		

B. If you knew *m*, could you calculate the length of the pendulum, *L*? (Check one.) (6 pts)

___ Yes ___ No

If yes, explain briefly how. If no, explain briefly why not.

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

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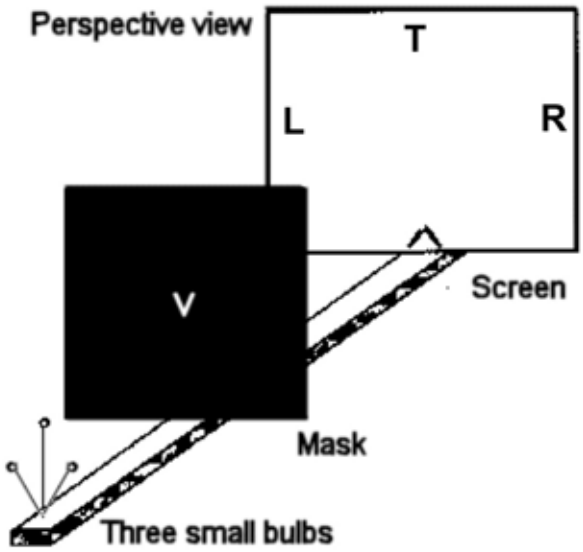
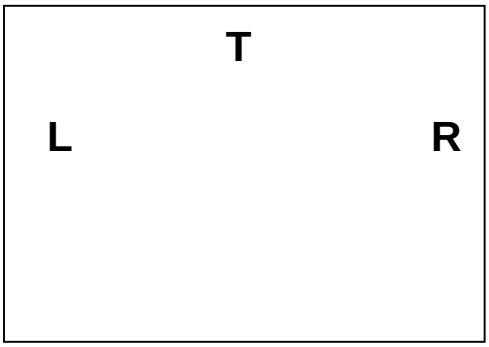
2. (20 points)

A.) In the figure at the right is shown an arrangement of three small light bulbs, a cardboard mask with a v-shaped hole in it, and a reflecting screen. The three bulbs form a triangle and lie in a plane parallel to the planes of the mask and screen.



In the box below, sketch what the pattern of light on the screen would look like. The letters "T", "L", and "R" indicate top, left and right respectively to show the orientation of the screen. (8 pts)



B.) A sinusoidal wave is traveling on a spring. It is well-described by the mathematical equation

$$y(x,t) = (0.02\ \text{m})\sin\left[\left(0.5\ \text{m}^{-1}\right)x - \left(2.0\ \text{s}^{-1}\right)t\right].$$

Find the amplitude, A, wavelength, λ, period, T, and the speed the wave is traveling down the spring, v_0. Put your values in the box at the right and explain your reasoning briefly in the space below. (12 pts)

A =

λ =

T =

v_0 =

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

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3. (15 points) In class we observed a wooden disk hung on a spring that looked something like the picture at the right. (Hanging next to the stretched spring on the right in the picture is an identical unstretched spring.) When it was pulled down we watched it oscillate and saw its oscillation die down. Estimate the spring constant of the spring and the fraction of energy that is lost to various damping factors in a single oscillation. *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.*

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4. (10 points) In discussing the motion of long taut springs, we have often referred to a model in which the spring is made up of massive beads connected by massless springs even though this is not what a real spring looks like. Did you find this model useful for making sense of any of the issues concerning motion of springs? If so, give an example and explain how it helped you. If it did not, discuss why you think we introduced it and why it was not useful.
Note: This is an essay question. Your answer will be judged not solely on its correctness, but for its depth, coherence, and clarity.

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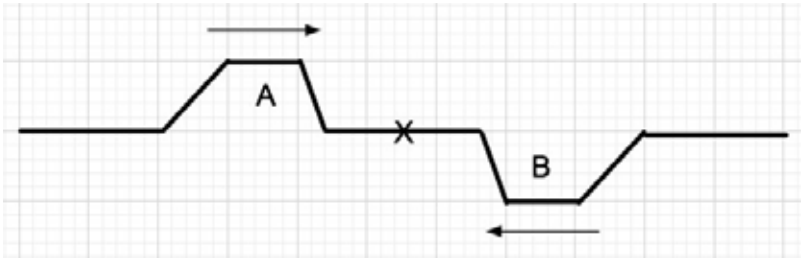
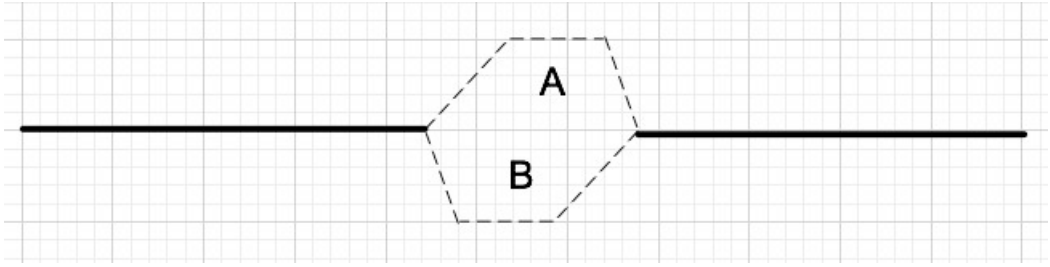
5. (25 points) In the figure below is shown a taut elastic string on which two pulses have been started. The pulse on the left (marked "A") is traveling to the right and the pulse on the right (marked "B") is traveling to the left. The bit of string exactly in between the two pulses is marked with an "X".



A. On the graph below, sketch the vertical velocity that the point X on the string would experience <u>if only the pulse A were present</u>. Although your graph is qualitative, be careful about relative velocities and times. Explain briefly why you drew the graph the way you did. (10 pts)

B. On the graph below, sketch the vertical velocity that the point X on the string would experience <u>if both pulses are present</u>. Although your graph is qualitative, be careful about relative velocities and times. Explain briefly why you drew the graph the way you did. (7 pts)

C. If both pulses are present, at some time later they would overlap perfectly as shown on the graph below. On this graph, sketch what you think the resulting shape of the string would look like and explain (on the back of this page) why you drew it the way you did. (8 pts)



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