Name__________________________________ Section ___________

University of Maryland
Department of Physics

Physics 121 — **Dr. E. F. Redish**

Fall 2008 — **Exam 1 (Makeup)** — **16. October 2008**

Instructions:

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

1. When the proctor tells you to begin, **<u>write your full name at the top of every page.</u>** 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. **<u>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!</u>**
3. On all the problems *except the multiple choice questions in problem 1 or where it says <u>not</u> to explain*, your answers will be evaluated at least in part on how you got them. If explanations are requested, more than half the credit of the problem will 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 make.
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 estimations 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 ******

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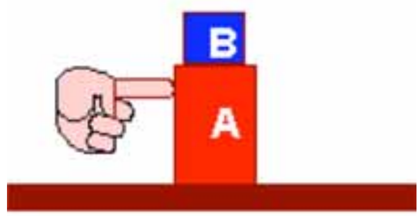
1. (24 points) A heavy block, labeled "A", is sitting on a table. On top of that block is a lighter block, labeled "B" as shown in the figure at the right.



For this problem you are asked to identify the direction of forces in this system under various circumstances. (3 pts each)

The labels in the subscripts indicate: A = block A, B = block B, F = finger, T = table. Specify the direction in your answers using the following notation:

- $\rightarrow$ means points to the right
- $\leftarrow$ means points to the left
- $\uparrow$ means point up
- $\downarrow$ means points down
- 0 indicates there is no such force at the instant specified.

You start pushing on block A as shown, but it is too heavy and does not move. <u>While you are pushing on block A but while it is not moving</u>, specify the direction of the following normal (N) and frictional (f) forces between the various objects indicated.

(a) $N_{A\rightarrow B}$ ______

(b) $f_{T\rightarrow A}$ ______

(c) $f_{A\rightarrow B}$ ______

(d) $N_{F\rightarrow A}$ ______

Now you push a little harder and the block begins to move. Block B moves with it without slipping. <u>While the block is speeding up</u> specify the direction of the following forces between the various objects indicated.

(e) $f_{B\rightarrow A}$ ______

(f) $f_{A\rightarrow B}$ ______

(g) $f_{T\rightarrow A}$ ______

(h) $N_{B\rightarrow A}$ ______

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

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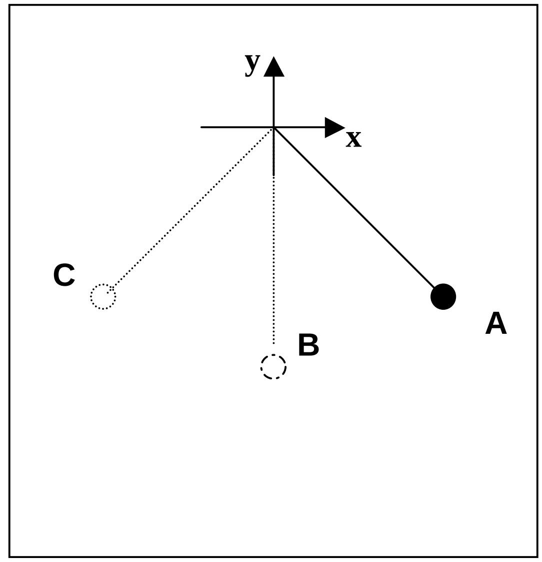
2. (25 points) A pendulum like the one you used in laboratory with a ball at the end is set swinging by holding it at the point marked A in the figure and releasing it. The *x* and *y* coordinate are shown with the origin at the crossing point of the axes and the positive directions indicated by the arrowheads

During one swing, the string breaks exactly at the bottom-most point of the swing (the point labeled B in the figure) as the ball is moving <u>from A to B towards C</u>.

Sketch on the figure the path of the ball after the string has broken and sketch qualitatively the x and y coordinates of the ball and the *x* and *y* components of its velocity on the graphs below. Take *t* =0 to be the instant the string breaks.
(5 pts for each graph)



x coordinate of the ball

y coordinate of the ball

x velocity of the ball

y velocity of the ball

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

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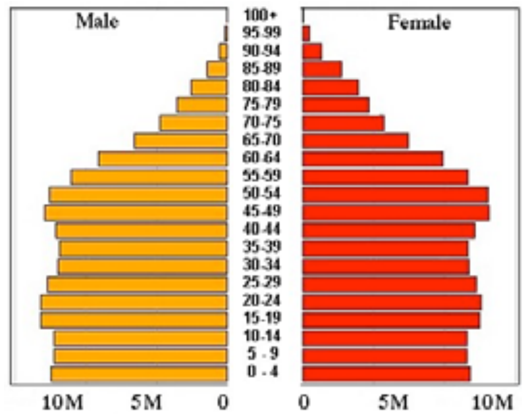
3. (15 points) Currently, the US population has almost the same number of people in each age up to age 60. It then falls off linearly. This is shown in the "pyramid" graph of population at the right. A reasonable approximation (at least for ages under 60) is to assume that there are the same number of people of each given age up to the age of 75 and none older.



Using this approximation, estimate the number of people in the US eligible to vote and the fraction of those who are college age (18-22).

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) A principle that we have identified in this class that is not usually given in introductory physics texts is the one we call "Newton's Zeroth Law." Describe clearly what we mean by this and discuss whether you have found it useful to use it in the context of problems. Include in your discussion an example of how it might be used to prevent someone from making an error in a particular situation. *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. (26 points) Jeff Gordon and Dale Earnhardt are racing their stockcars to try to win the Daytona 500. Jeff makes a pit stop to gas up and change his tires. When he gets back on the track, he discovers that he is right next to Dale. Both are traveling at speeds of 150 mi/hr, but Dale is one full lap (2.5 miles) ahead.*

Jeff wants to catch Dale so he decides to try to accelerate slowly and uniformly (constant a) for the next 10 laps so that he will catch Dale by the time that he has done those 10 laps. (Jeff knows from studying physics that uniform acceleration will use less gas than a "jackrabbit" jump to a higher speed.)

(a) How much time does he have to do it, assuming that Dale keeps a constant speed during those 10 laps? (4 pts)

T_D =

(b) What distance will Jeff have to cover in that time? (4 pts)

Δx_J =

(c) Again, assuming that Dale keeps a constant speed, what does Jeff's average speed have to be in order to catch Dale after Dale has gone 10 laps? (6 pts)

$\langle v_J \rangle$ =

(d) What would Jeff's speed be when he catches Dale? (6 pts)

v^f_J =

(e) What was Jeff's acceleration during the time Dale was going 10 laps? (6 pts)

a_J =

* For those not familiar with NASCAR racing, in this race the cars travel around a 2.5 mi oval track 200 times. During the long time that this race takes, cars have to make pit stops for service – gas, new tires, etc.

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