

Name _____ Section _____

**University of Maryland
Department of Physics**

**Physics 121
Fall 2003**

Exam 1 (Makeup)

**Dr. E. F. Redish
16. October, 2003**

Instructions:

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

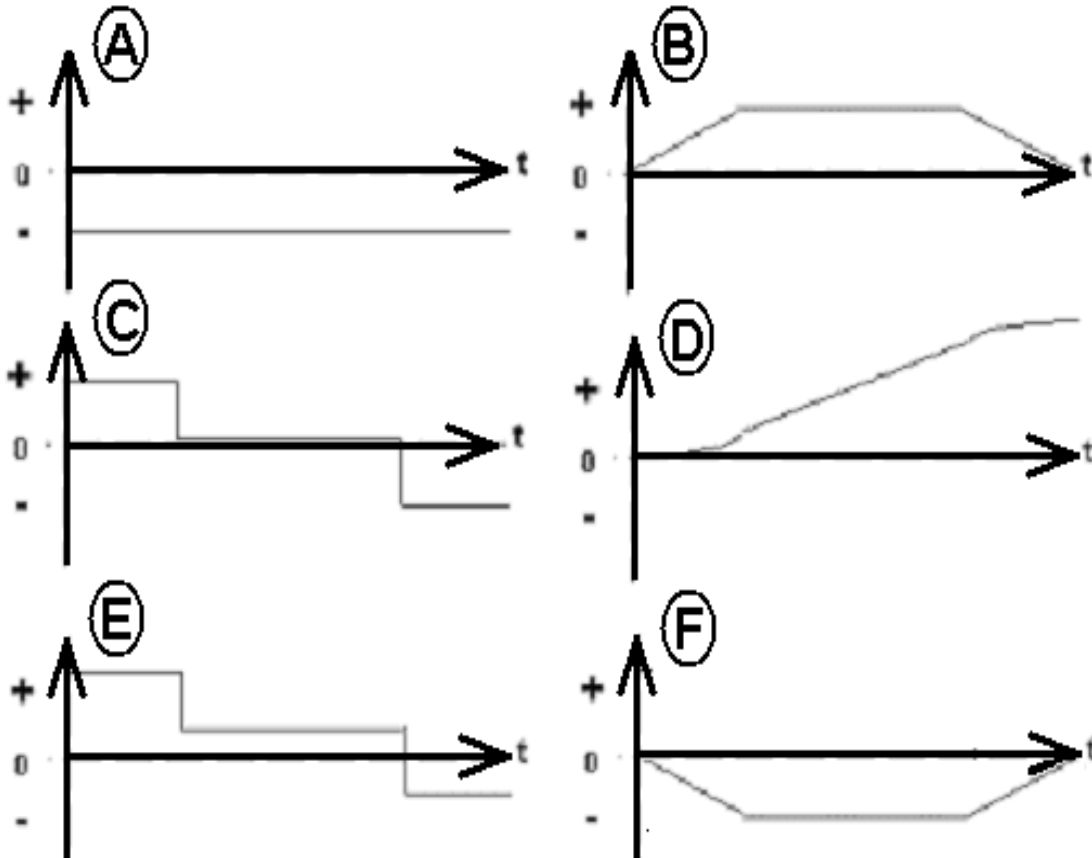
1. When the proctor tells you to begin, **write your full name and section number at the top of every page.** This is essential since this exam booklet will be separated for grading.
2. Do your work for each problem on the page for that problem. You might find it convenient to either do your scratch 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. If explanations are requested, more than half the credit of the problem will be given for the explanation. **LITTLE OR NO CREDIT MAY BE EARNED FOR ANSWERS THAT DO NOT SHOW HOW YOU GOT THEM.** Partial credit will be granted for correct steps shown, even if the final answer is wrong.
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. All estimations should be done to the appropriate number of significant figures.
6. 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 examination.”

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#1:	#2:	#3:	#4:	#5:	Total
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***** Good Luck *****

1. (30 points) A worker is pushing a cart along the floor. At first, the worker has to push hard in order to get the cart moving. After a while, it is easier to push. Finally, the worker has to pull back on the cart in order to bring it to a stop before it hits the wall. The force exerted by the worker on the cart is purely horizontal. Take the direction the worker is going as positive. The cart begins moving at time $t = 0$.



Above are shown graphs of some of the physical variables of the problem. Match the graphs with the variables in the list below. You may use a graph more than once or not at all. (Note: the time axes are to the same scale, but the ordinates {"y axes"} are not.)

- _____ a. friction force exerted on the cart by the floor
- _____ b. force exerted by the worker on the cart
- _____ c. net force on the cart
- _____ d. acceleration of the cart
- _____ e. velocity of the cart
- _____ f. force exerted by the cart on the worker

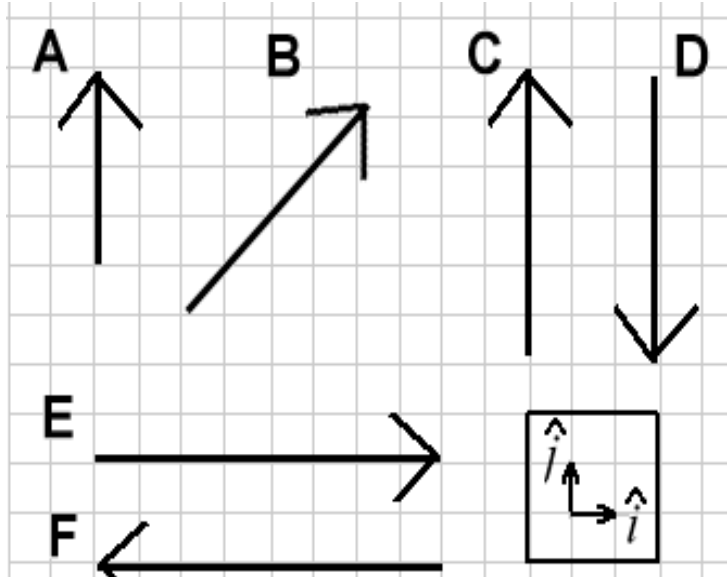
If you need more space, continue on the back and check here.



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2. (20 points) In the figure at the right is shown a set of vectors on a grid. The grid spacing is such that each unit of the grid is 1 unit of whatever the vector represents. So for a displacement vector, interpret each grid unit as 1 cm. For a velocity vector, interpret each grid unit as 1 cm/s, etc. In a box at the lower right are shown the unit direction vectors \hat{i} and \hat{j} indicating the positive horizontal and vertical directions respectively. (The vectors A-F are intended to have integer values of their horizontal and vertical coordinates.)



For each of the items below, specify the result, using the unit directions given for any vectors.

(a) Take A, B, and F to be displacement vectors.

What is the vector $2A - B + F$? _____

(b) Take C and D to be initial and final velocity vectors respectively.

What is the change in velocity, Δv ? _____

(c) Take C and D to be initial and final velocity vectors respectively.

If they have changed from one to the other at a constant acceleration, what is the average velocity during the change, $\langle \vec{v} \rangle$? _____

(d) If an object makes a displacement given by the vector E in 2 s followed by the displacement F in 3 s, what is the object's average speed during the displacements? _____

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



NAME _____ SECTION _____ POINTS _____

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3. (15 points) I have seen it stated that different animals tend to have approximately the same numbers of heartbeats in their average lifespans. Using this idea and what you know about humans and dogs, estimate the typical heart rate (in beats per minute) of a dog. Is your result plausible?

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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5. (25 points) You are holding your physics book against the wall by pressing on it as shown in the figure at the right.

- (a) You are pressing hard enough so that the book doesn't move. Draw a free-body diagram for the book, being sure to identify for each force the kind of force, what object is causing it, and what object is feeling it. (6 pts)



- (b) Which forces in your diagram have equal magnitude? How do you know? (4 pts)

(c) You begin to get tired and the book begins to slide down. The book begins to slide down, and you respond so it slides down at a constant velocity. How do each of the forces you have identified change from their magnitudes in part (a)? Explain how you know. (10 pts)

(d) If the book has a mass of 2 kg, the coefficient of friction between the sliding book and the wall is 0.4, how hard do you have to press on the book if it is sliding down with a speed of 2 cm/s? (5 pts)

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

