

Name \_\_\_\_\_ Section \_\_\_\_\_

**University of Maryland  
Department of Physics**

**Physics 121  
Fall 2003**

**Exam 2**

**Dr. E. F. Redish  
14. November, 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 problems 1 and 5 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.”

--

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

**\*\*\* Good Luck \*\*\***

Physics 121  
Fall 2003

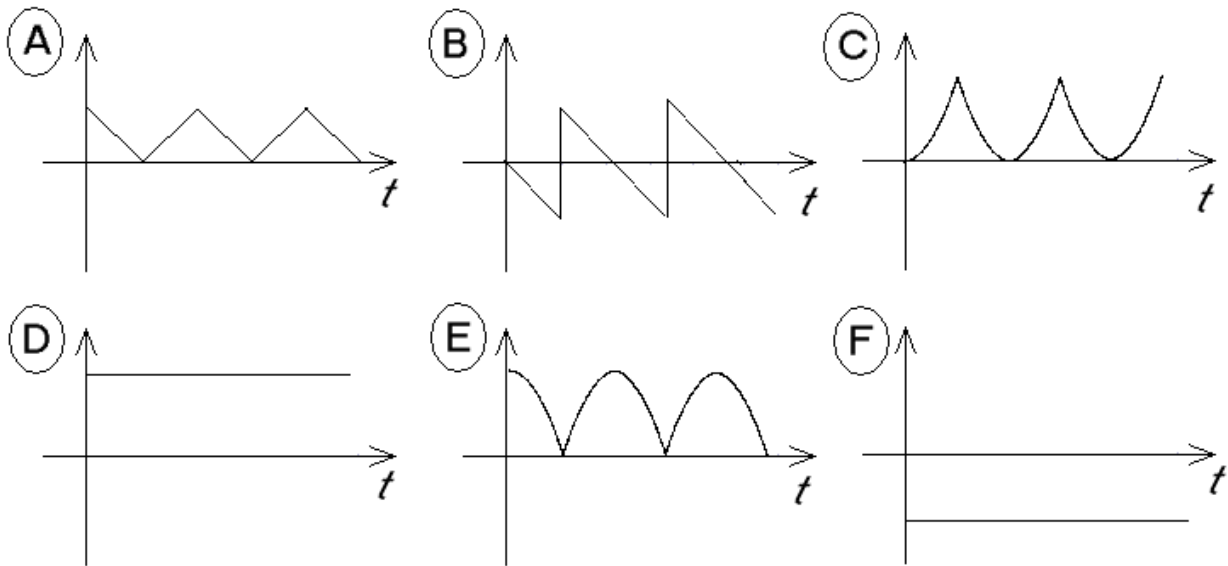
Dr. E. F. Redish  
Exam 2

1. (30 points) A superball is dropped from a height of 1 m and bounces a number of times before it is caught. Below are shown graphs of some of the physical variables of the problem. Match the graphs that best show the time dependence of the variables in the list below the graphs. You may use a graph more than once or not at all. If none of the graphs work well for a variable, put N.

(Assume for these first few bounces the superball can be treated as a “perfect bouncer.”)

Note: the time axes are to the same scale, but the ordinates {“y axes”} are not.

Use a coordinate system in which the positive direction is taken as up and the origin is at the floor. (No explanations are required for this problem.)

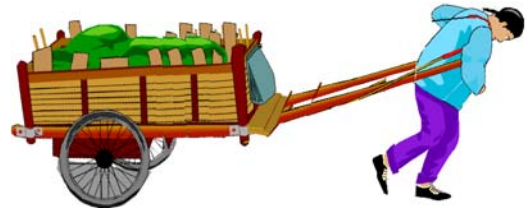


- \_\_\_\_\_ a. The velocity of the ball
- \_\_\_\_\_ b. The kinetic energy of the ball
- \_\_\_\_\_ c. The potential energy of the ball
- \_\_\_\_\_ d. The momentum of the ball
- \_\_\_\_\_ e. The position of the ball
- \_\_\_\_\_ f. The total mechanical energy of the ball.

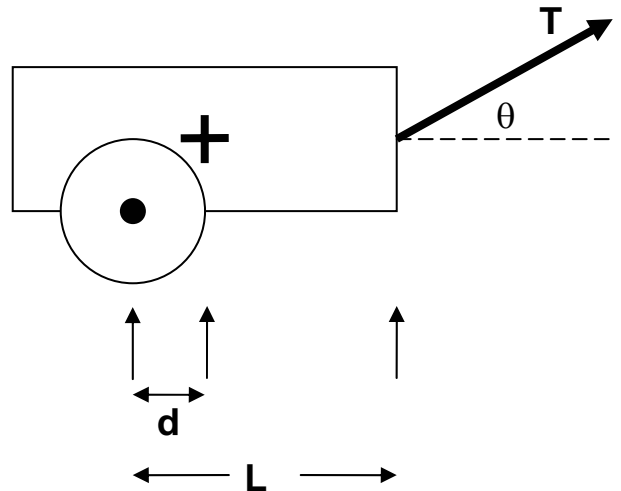
If you need more space, continue on the back and check here.



2. (30 points) A worker is pulling a cart as shown in the picture at the right. Schematically, the situation is as in the diagram sketched at the right below.



(a) The center of mass of the cart is a distance  $d$  forward of the wheel's axle as shown by the cross in the picture. If the worker wants to keep the cart from tipping forward, should he use a bigger angle or a smaller angle? Explain your answer briefly, using an equation and the physics we have learned. (5 pts)



(b) If the worker wants to get the cart moving and bring its speed up from zero, should he use a bigger angle or a smaller angle? Explain your answer briefly, using an equation and the physics we have learned. (5 pts)

(c) If the cart has a mass of 50 kg,  $d = 1$  m and  $L = 2$  m, and the worker is pulling at an angle of  $30^\circ$ , how hard does he have to pull to keep the cart from tipping over? (10 pts)  
(Note:  $\sin 30^\circ = 0.5$ ,  $\cos 30^\circ = 0.866$ , and  $\tan 30^\circ = 0.577$ .)

(d) If he pulls the cart with the force you found in part (c), how fast will the cart be going after he has pulled it for 2 m? (10 pts)

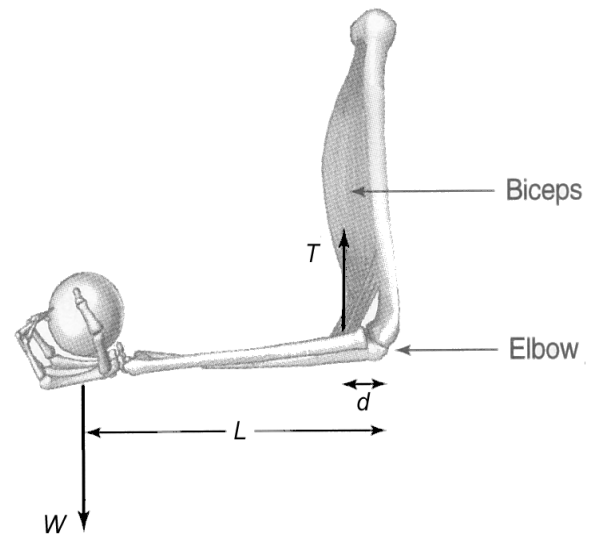
If you need more space, continue on the back and check here.



Physics 121  
Fall 2003

Dr. E. F. Redish  
Exam 2

3. (15 points) When you hold an object in your hand, the weight of the object has to be countered by the tension in your biceps. The relevant forces are shown schematically in the figure at the right. Using the physics we have learned and your own arm, estimate the tension in your biceps needed to hold a 1 kg weight in your hand. *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.*

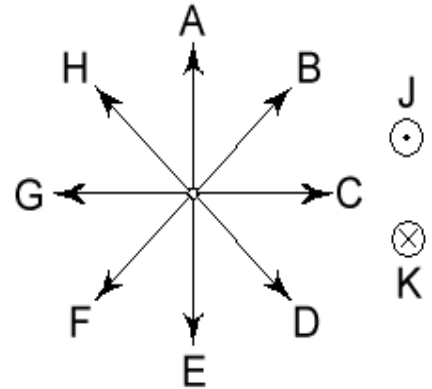


If you need more space, continue on the back and check here.





5. (15 points) The next three questions ask about directions. Use the direction labels on the vectors in the figure at the right to specify your answers. Use N if none of the labels work. (No explanations are required on this problem.)



5.1 The direction of  $\vec{F} \times \vec{H}$ .

5.2 The direction of  $\vec{B} \times \vec{F}$ .

5.3 A hockey puck is sliding across the ice without spinning. It hits the wall and bounces off elastically (again without spinning) as shown in the figure at the right. What is the direction of the change in the momentum of the hockey puck?

