

Name _____ Section _____

**University of Maryland
Department of Physics**

**Physics 121
Fall 2003**

Exam 2 (Makeup)

**Dr. E. F. Redish
20. 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.”

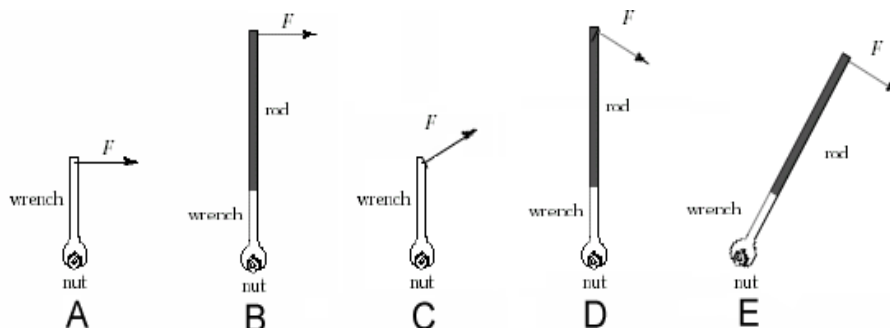
--

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

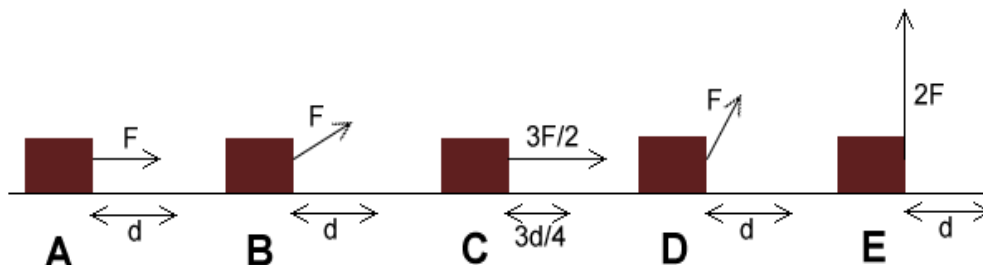
***** Good Luck *****

1. (30 points) For each of the following three problems, rank the quantity indicated from the greatest to the smallest. The notation “ $A > B$ ” means “A is greater than B”. So, to say “A is greater than B and B is equal to C” write “ $A > B = C$ ”. (10 pts each)

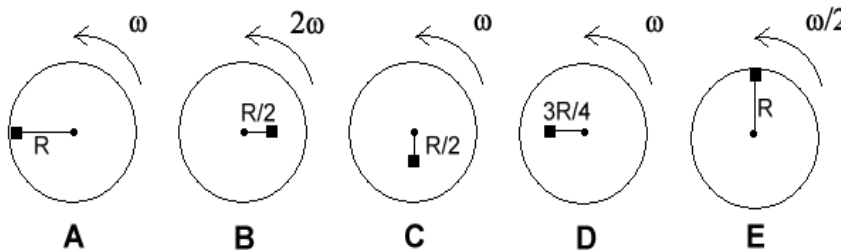
1.1 Rank the magnitude of the torques produced by the force F .



1.2 Rank the change in the kinetic energy produced by the force F if the box moves through the indicated distance.



1.3 Rank the magnitude of velocity of the little boxes attached to a rotating disk. Each disk is rotating at the indicated angular velocity and the box is the indicated distance from the disk's center.



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

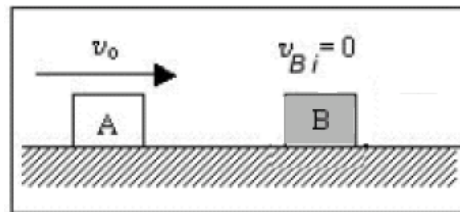


Physics 121
Fall 2003

Dr. E. F. Redish
Exam 2 (M.U.)

2. (20 points) Two carts of equal mass are floating on a level air track so that they move horizontally with essentially no friction.

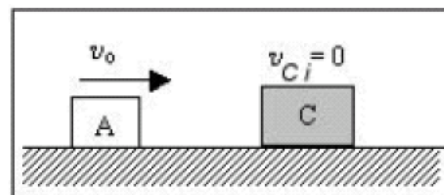
(a) Cart B is stationary and cart A approaches it from the left with a velocity v . It collides elastically (there are metal springs on the ends of the carts) so that no mechanical energy is lost in the collision. Will the momentum of each cart be conserved or not? Explain. (5 pts)



(b) Will the total momentum of the system (the two carts taken together) be conserved or not? Explain the reasons for your answer. (5 pts)

(c) The metal springs on the carts are replaced by Velcro so the carts will stick together when they hit. Will the mechanical energy of the system (the two carts) be conserved or not? Explain the reasons for your answer. (5 pts)

(d) Cart B is replaced by cart C, which has twice the mass of cart A. If cart A has a mass of 1 kg and approaches cart C with a speed of 30 cm/s, with what speed will they travel after they have hit and stuck together? (5 pts)



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



NAME _____ SECTION _____ POINTS _____

Physics 121
Fall 2003

Dr. E. F. Redish
Exam 2 (M.U.)

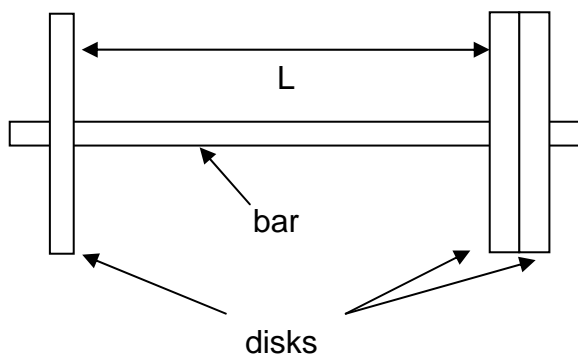
3. (15 points). One of the activities for the annual high school Physics Olympics competition is the “egg drop.” Students create packaging that allows them to drop a raw egg off the top of the physics building to land on the ground undamaged. Some packages involve parachutes to slow the fall of the egg, but some don’t. In one version, the packaging can have a mass equal to no more than the mass of the egg. For a packing that does NOT involve slowing the fall using air resistance, estimate how much energy the packing has to absorb when it hits the ground so that the egg does not break. *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. (25 points)

(a) A weightlifter wants to do exercise lifting 75 pounds with one hand, but he only has a light (but strong) aluminum bar and three steel disks weighing 25 pounds each. He can set them up as in the figure, but then finds that they are unbalanced if he tries to lift the bar holding it in the middle. Where should he hold the bar so that the weights are balanced? Assume you can ignore the weight of the bar and that the disks are thin compared to the distance L between them. (15 pts)



(b) While waiting to have the disks attached, he balances a baseball bat on his finger as shown. His friend comments, “That must be where the center of mass is.” Is the friend right? How do you know? (5 pts)



(c) When the bat is balanced is there more of the bat’s mass to the left of the weightlifter’s finger, more to the right, or is it the same on both sides? How do you know? (5 pts)

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

