

Name _____ Section _____

**University of Maryland
Department of Physics**

**Physics 121
Fall 2007**

Exam 2 (Makeup)

**Dr. E. F. Redish
29. November 2007**

Instructions:

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

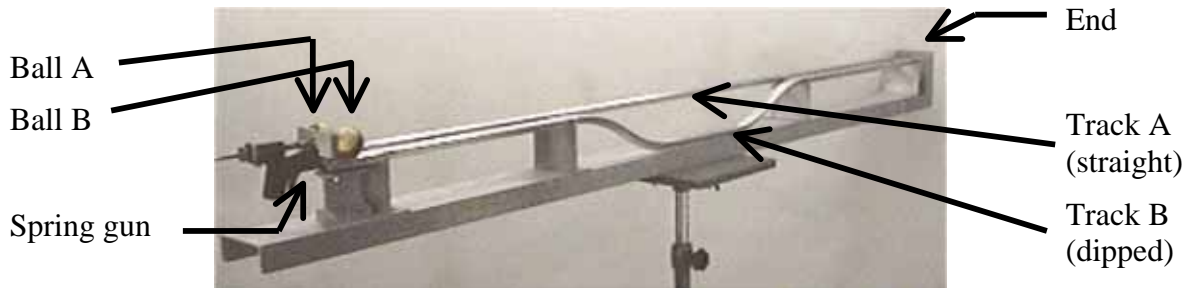
1. When the proctor tells you to begin, **write your full name and section number at the top of every page.** This is essential since this exam booklet will be separated for grading.
2. Do your work for each problem on the page for that problem. You might find it convenient to either do your scratch 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. 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 examination.

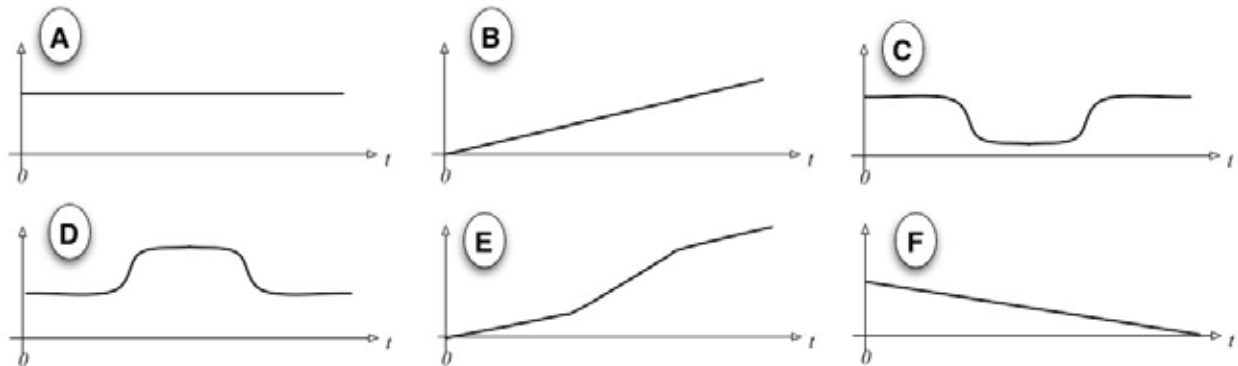
#1:	#2:	#3:	#4:	#5:	Total
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***** Good Luck *****

1. (30 points) In lecture we observed two billiard balls that were driven down parallel tracks by a spring gun. One ball traveled along a flat track, the other along a track with a dip. The apparatus is shown in the figure below.



Below are shown 6 graphs and 10 physical quantities. Identify which of the graphs could match each physical quantity if the vertical axis were given the correct scale. The time $t = 0$ occurs just after the balls have been pushed by the spring. Choose the graphs that match each quantity a.-j. If none works, write N. Each graph may be chosen as many times as you like. You may assume friction can be neglected. *No explanations are required on this problem.* (3 pts each)



- | | |
|---------------------------------------|-----------------------------------|
| a. ___ The kinetic energy of ball A | f. ___ The total energy of ball B |
| b. ___ The potential energy of ball A | g. ___ The velocity of ball A |
| c. ___ The kinetic energy of ball B | h. ___ The velocity of ball B |
| d. ___ The potential energy of ball B | i. ___ The position of ball A |
| e. ___ The total energy of ball A | j. ___ The position of ball B. |

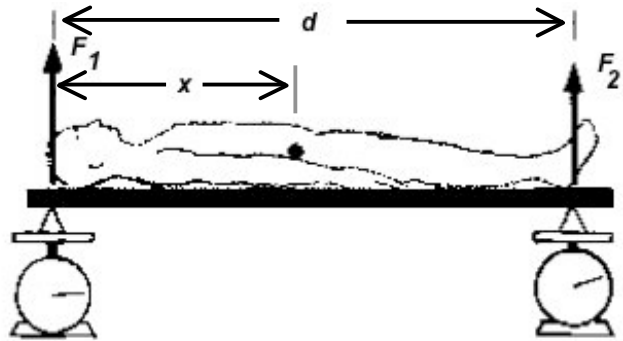
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2. (20 points) One way to measure the position of the center of gravity of a person (marked by a black circle) is to support them with two scales as shown in the figure at the right. The height of the person is d , the distance from the top of their head to their center of gravity is x , and the person's weight is W .



(a) If the scale at the left reads F_1 and the scale at the right reads F_2 find the distance x in terms of the other given parameters. Be sure to explain carefully (but briefly!) what physics you are using. (8 pts)

(b) You want to use a long metal bar to lift up the corner of a heavy stone block. For the four arrangements shown below, rank them in order of their effectiveness in raising the stone. The arrow in each figure indicates where you are pushing and in what direction. If two are equal, indicate that. (Your answer should be a string of letters that looks something like $E = F > G > H$ meaning E and F are the biggest and H is the smallest.)
No explanation is required on this problem. (12 pts)



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3. (15 points) In a proposed episode that Disney is considering for teen superhero Kim Possible[®], Kim is planning to lasso the (large) bad guy Duff Killigan and swing him around her head.

If Kim is holding the rope so that there is 3 m of rope from her hand to the lasso's loop and if Duff has a mass of 150 kg, estimate how much force Kim would have to exert on the rope in order to keep him swinging around in a circle. Is this a plausible amount of force for a teenage superhero to exert? *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.*

A large, empty rectangular box with a thin black border, intended for the student to write their answer and reasoning. The box is divided into four quadrants by two diagonal lines that intersect at the center.

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



5. (25 points) Making a rest stop at a service station on the highway, the driver of a pickup truck turned off his truck, left it in neutral, and ran into the building, forgetting to set his emergency brake. Unfortunately, he was parked on a slight incline and the truck started to roll down.



When the truck got to the bottom of the incline, the road was flat and smooth and the truck rolled on without slowing significantly. After traveling a short distance, it ran into a Porsche. The driver of the Porsche also had left her car in neutral without setting the emergency brake. (Bad idea!) The truck was going pretty slowly and had a rubber bumper so when it hit the car, the car bounced off. For the period of the collision, friction with the ground was negligible.

Here are the parameters of what happened.

- Distance van traveled after coming off the incline before it hit the car = 37 ft.
- Mass of the truck = 2000 kg.
- Mass of the car = 1000 kg.
- Time car and truck are in contact = 1.5 s.
- Truck's speed just before it hit the car = 10 km/hr.
- Truck's speed just after the car and van separate = 5 km/hr.

a) What was the speed of the car after the collision? Explain how you know. (10 pts)

$v_{car}^f =$

b) Is the information given enough to calculate the average force felt by the car? If so, calculate it. If not, explain why not. (5 pts)

$F_{truck \rightarrow car} =$

c) Is the information given enough to calculate the average force felt by the truck? If so, calculate it. If not, explain why not. (5 pts)

$F_{car \rightarrow truck} =$

d) How much mechanical energy was lost in the collision, if any? (This will determine how much damage the bumpers suffered.) (5 pts)

Mech. En. lost =

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

