Physics 2048 Test 3 Fall 2000

Dr. Jeff Saul

Name:

READ THESE INSTRUCTIONS BEFORE YOU BEGIN

- Before you start the test, **WRITE YOUR NAME ON EVERY PAGE OF THE EXAM.**

- Calculators are permitted, but no notes or books are allowed

- If you have ANY questions while taking the test, please be sure to ask me. The purpose of the test is not to give you trick problems to catch you in an error. The purpose is to give you an opportunity to "show what you know!"

- On problems 2, 4, & 5 your answers will be evaluated on how you got them. Remember that to get full credit on a problem you will need to
  - Make a list of given information and indicate what you are trying to find
  - Start from general principles
  - Solve for the unknown quantity in symbols before plugging in numbers
  - Substitute numbers with units
  - Include units with all numeric quantities

  Partial credit will be given for correct steps shown, even if the final answer is wrong.

- Write clearly and logically so that I can understand what you are doing and can give you as much partial credit as you deserve. I cannot give credit for what you are thinking, only for what you show on your paper.

- If on a multistep problem you can't do a particular part, don't give up. Go on to the next part anyway. If necessary, define a variable name for the quantity you couldn't find and express your answer in terms of it.

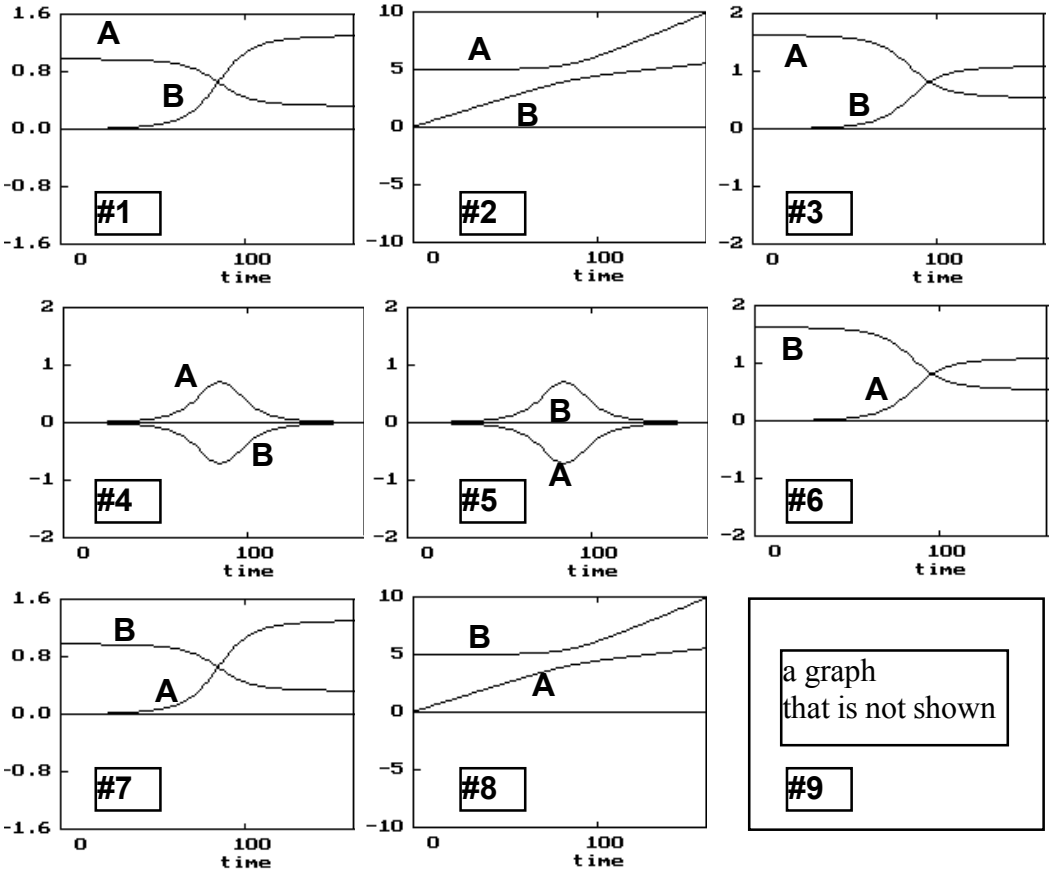
Problem	Points Possible	Score
1	25	
2	20	
3	10	
4	20	
5	25	
Total	100	

Problem 1 (25 points) Short Answer/Multiple Choice Section

Two carts are riding on an air track as shown in the figure at the right. At clock time t = 0 cart B is at the origin traveling in the +x direction with a velocity speed v_{B0}. At that time, cart A is at the position shown and is at rest. Cart B has twice the mass of cart A. The carts "bump" each other, but don't stick.

In the graphs below are shown a number of possible plots for the various physical parameters associated with the two carts. Each graph has two curves, one for each cart and labeled with the cart's letter. For each property (a)-(e) select the letter of the graph that could be a plot of the property.

(a) The force <u>exerted by</u> the carts.
(b) The position of the carts
(c) The velocity of the carts
(d) The acceleration of the carts
(e) The momentum of the carts.



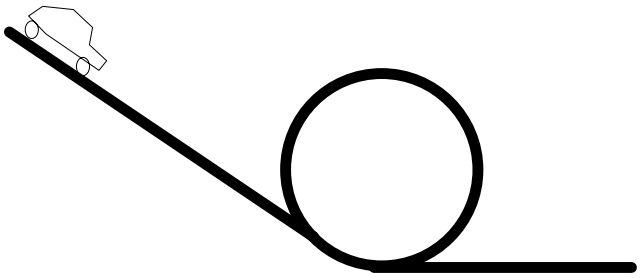
Problem 2 (20 points) Estimation Question

What is the stiffness in the springs in the bumper on your car if a 5 MPH collision makes the springs compress 1 inch?

Problem 3 (10 points) Essay Question

You may use diagrams, equations, and words, but not calculations to answer this problem.

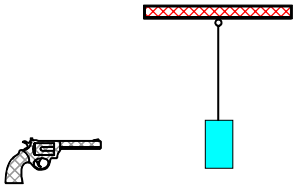
You want to show your appreciation to the school by performing a stunt during the half-time show of the Homecoming football game. You are going to drive a car through the circular ramp (Radius R) shown below. You definitely want to stay on the track the whole time. You know that you and your car have a mass of M.



Assuming that the car just coasts from rest, explain how you could use conservation of energy to determine the minimum starting height for you and the car to make it through the circular loop.

Problem 4 (20 points)

A bullet of mass m_1 is fired with a speed v into the wooden bob of a pendulum having mass m_2. The bob is attached to a very light rigid rod of length L that is pivoted at the other end.

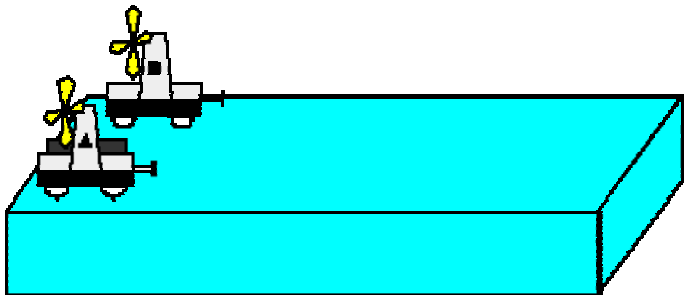


(a) The bullet is stopped in the bob. How high will the bob rise?

(b) A narrower bob with the same mass is used instead of the original one. This time, the bullet passes through the bob, emerging with a speed v/2. Now how high will the bob rise?

Problem 5 (25 points)

21) Two fan carts labeled A and B are placed on opposite sides of a table with their fans pointed in the same direction as shown in the figure below. Cart A is weighted with iron bars so it is twice as heavy as cart B. When the fans are turned on, they provide a constant force of the cart independent of its mass. Assume that friction is small enough to be neglected. The fans are set with a timer so that after they are switched on, they stay on for a fixed length of time, Δt, and then go off.



(a) Just after the fans go off, which of the following statements are true about the momenta of the two carts?

(i) $p_A > p_B$

(ii) $p_A = p_B$

(iii) $p_A < p_B$

(b) Just after the fans go off, which of the following statements are true about the kinetic energies of the two carts?

(i) $KE_A > KE_B$

(ii) $KE_A = KE_B$

(iii) $KE_A < KE_B$

(c) Which of the following statements are true? You may choose as many as you like, or none. If you choose none, write N.

(i) After the fan is turned on, each cart moves at a constant velocity, but the two velocities are different from each other.

(ii) The Kinetic energy of each cart is conserved.

(iii) The momentum of each cart is conserved.