Physics 2048 Final Exam
Dr. Jeff Saul
Fall 2001

Name:______________________
Table:________
Date:__________________

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 multi-step 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
Group Problem	30	
1	25	
2	15	
3	15	
4	20	
5	20	
Diagnostic Test	25	
Total	100	

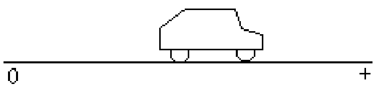
Name________________________________

Problem 1a (Short Answer: 18 points)

no explanation required, but no partial credit either.

The following questions refer to a toy car which can move to the right or left along a horizontal line (the positive part of the x-axis).

Assume that friction is so small it can be ignored.



A force is applied to the car. Choose the one force graph that (**A** through **H**) for each statement below which could allow the described motion of the car to continue.

You may use a graph more than once or not at all. If you think that none is correct, answer choice **J**.

_____ The car moves to the right (away from the origin) with a steady (constant velocity).

_____ The car is at rest.

_____ The car moves towards the right and is speeding up at a steady rate (constant acceleration).

_____ The car moves towards the left (toward the origin) with a steady (constant) velocity.

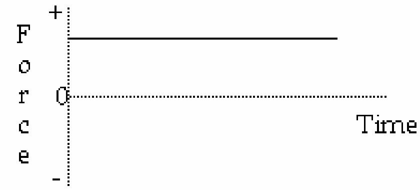
_____ The car moves towards the right and is slowing down at a steady rate (constant acceleration).

_____ The car moves towards the left and is speeding up at a steady rate (constant acceleration).

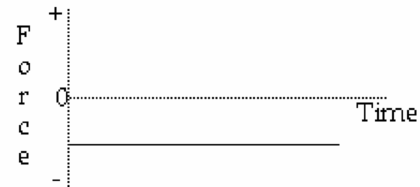
_____ The car moves towards the right, speeds up and then slows down.

_____ The car was pushed towards the right and then released. Which graph describes the force after the car is released?

(A)



(B)



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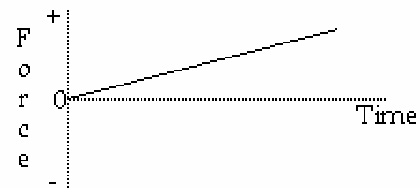
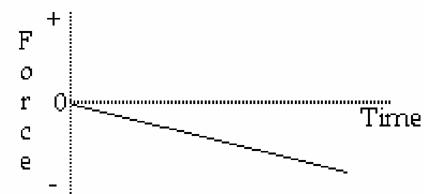
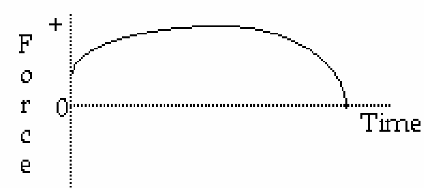


(D)

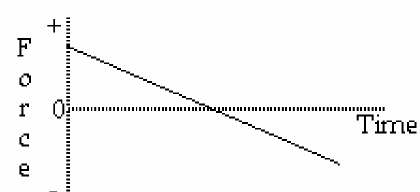


(E)

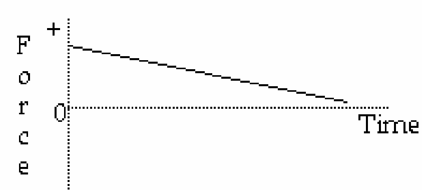
(F)



(G)



(H)



(J) **None of these graphs is correct.**

Name______________________________

Problem 1b (Short Answer: 7 points) no explanation required, but no partial credit either.

Two carts roll toward each other on a level table. The vectors represent the velocities of the carts just before and just after they collide.

A. Draw and label a vector for <u>each cart</u> to represent the *change in velocity* from before to after the collision.

B. How does the direction of Cart A's average acceleration compare to the direction of Cart B's average acceleration over the time interval shown?

C. Is the magnitude of Cart A's average acceleration *greater than, less than* or *equal to* the magnitude of Cart B's average acceleration over the time interval shown?

Name______________________________

Problem 2 (Estimation Problem: 15 points)

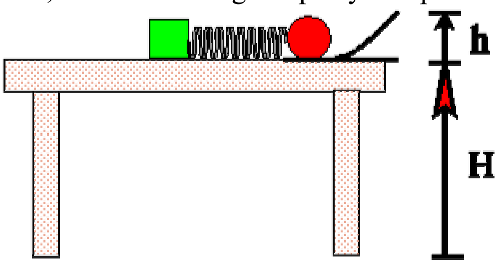
Suppose an elevator with a mass of 1000 kg lifts 3 people from the 1^{st} floor to the 4th floor of a building. The elevator is connected by a cable to an electric motor at the top of the shaft.

- How much work is done by the cable on the elevator?
- How much work is done by the Earth's gravity on the elevator?
- What is the net work done on the elevator?

Name______________________________

Problem 3 (Essay 15 points) You may use diagrams, equations, and words, but not calculations to answer this problem.

A child's game consists of a block that attaches to a table with a suction cup, a spring connected to that block, a ball, and a launching ramp. By compressing the spring, the child can launch the ball up the ramp.



The spring has a spring constant k, the ball has a mass m, and the ramp rises a height h. The spring is compressed a distance s in order to launch the ball. When the ball leaves the launching ramp its velocity makes an angle θ with respect to the horizontal.

- Assuming that friction and air resistance can be ignored for the purposes of this problem, describe the changes in the forms of energy in the system from the time the spring is compressed until the ball first hits the ground.
- How you could use an energy perspective to find the speed of the ball when it hits the floor?

Name______________________________

Problem 4 (20 points)

Two blocks collide on a frictionless surface. After the collision the two blocks stick together. Block A has a mass M and is initially moving at speed V. Block B has a mass 2M and is initially at rest. System C is composed of both blocks.

a) Draw a free body diagram for each block at an instant during the collision.

b) Rank the magnitudes of the horizontal forces in your diagram. Explain your reasoning.

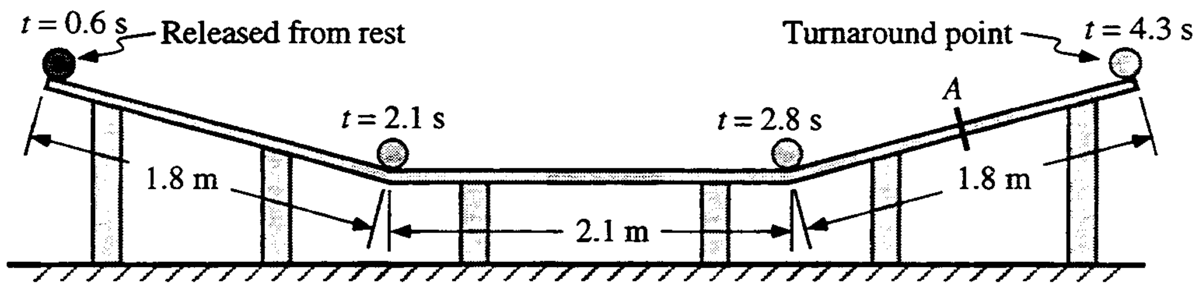
c) Calculate the change in momentum of block A, block B, and system C. Show all work.

d) Is kinetic energy conserved in this collision? Explain your reasoning.

Name______________________________

Problem 5 (20 points)

A ball is released from rest at the point shown on the incline. It then rolls onto a level section of track, and then onto a second incline with the same slope as the first. The diagram below shows the location of the ball at several instants in time. NOTE: THIS IS NOT A STROBE PHOTOGRAPH OR MOTION DIAGRAM.



A. Determine the speed of the ball at t = 2.1 s. Show your work.

B. Determine the magnitude of the acceleration of the ball at point A (halfway up the second incline). Show your work.

C. On the diagram above, draw an arrow indicating the direction of the acceleration of the ball at point A. Explain why you drew the arrow the way you did.

D. On the diagram above, draw an arrow indicating the direction of the acceleration of the ball at t = 4.3 s (the turnaround point). If the acceleration at the turnaround point is zero, state that explicitly. Explain why you drew the arrow the way you did.

E. Graph Speed vs. time graph for the ball's motion from t = 0.6 s to t = 4.3 s. (Show calculations)