Physics 2048 Test 3 Name:_____
Dr. Jeff Saul Table:_____
Spring 2001 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.

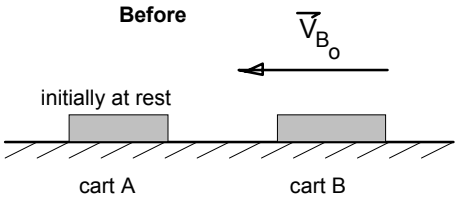
- Write clearly and logically so that I can understand what you are doing and can give you as much partial credit as you deserve. I cannot give credit for what you are thinking, only for what you show on your paper.

- 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	25	
1	15	
2	15	
3	10	
4	15	
5	20	
Total	100	

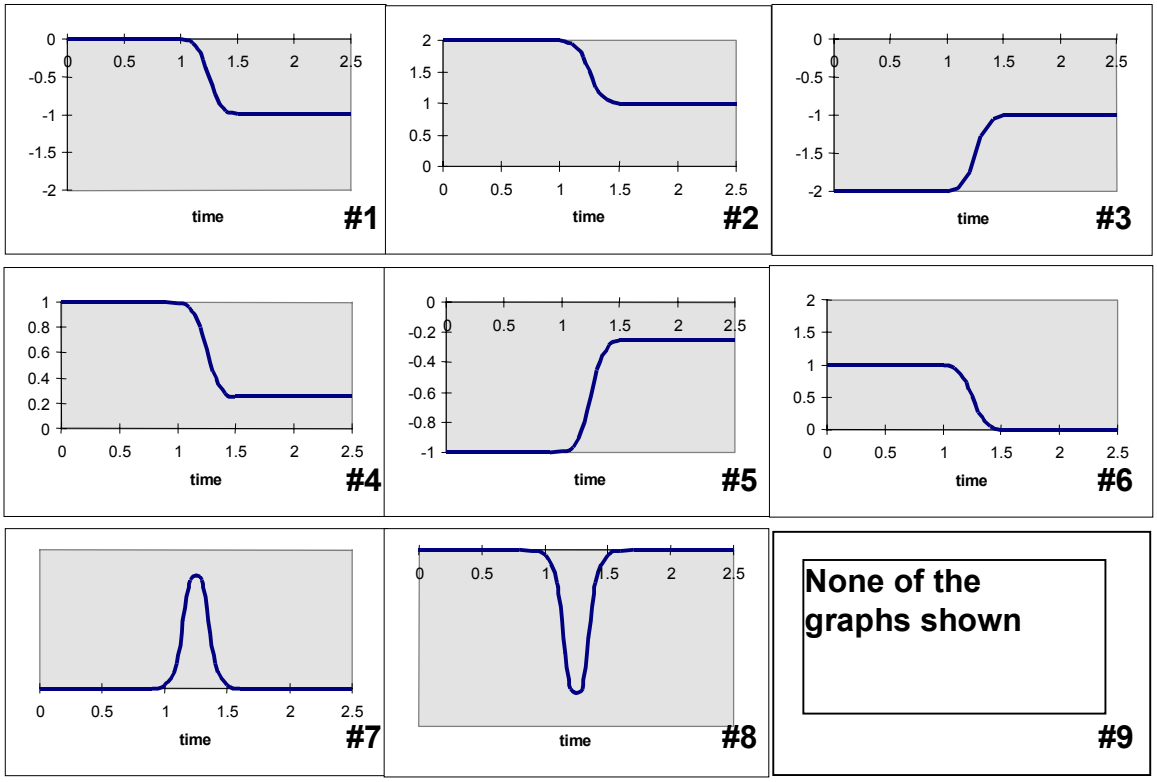
Problem 1 (Short Answer: 15 points) no explanation required, but no partial credit either.

In the figure at the right are shown two carts on an air track. The carts have equal masses. At the time shown, cart B is moving in the negative x direction and the center of mass of cart A is at the origin and at rest. When the carts collide, they stick together. Friction with the track is small and may be neglected.



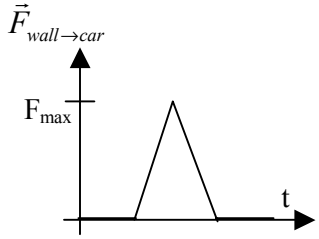
In the graphs below are shown a number of possible plots for the various physical parameters associated with one of the two carts. For each property (a)-(f) select the number of a graph that could be a plot of the property as a function of time. You may use a graph more than once or not at all.

(a) the momentum of cart A
(b) the momentum of cart B
(c) the kinetic energy of cart B
(d) the position of (the center of mass) of cart B
(e) the acceleration of cart A
(f) the total momentum of carts A+B



Problem 2 (Estimation Problem: 15 points)

In a test of a new and improved automobile bumper conducted by the National Transportation Safety board, a car collides with the with a brick wall while moving forward at 25 MPH. The car bounces off the wall moving backwards with 90% of it's original speed. Using the force vs. time graph of the force exerted by the wall on the bumper shown below), what is the maximum value of this force? (Hint: you will need to estimate how long the car is in contact with the wall.)

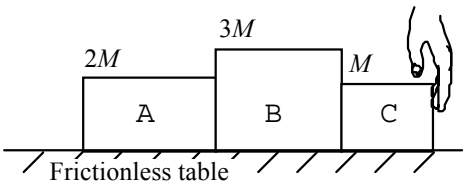


Problem 3 (Essay 10 points) You may use diagrams, equations, and words, but not calculations to answer this problem.

Antilock brakes prevent the wheels of your car from locking up or skidding when braking. Why does this make driving, particularly in the rain, safer?

Problem 4 (15 points)

Blocks A, B, and C are being pushed across a frictionless table by a hand that exerts a constant horizontal force. Block A has mass 2*M*, block B has mass 3*M* and block C has mass *M*.



A. [9pts] Draw separate free-body diagrams for each of the three blocks. Label your forces to make clear (1) the object on which the force acts, (2) the object exerting the force, and (3) the type of force (normal, frictional, gravitational, etc.)

Free-body diagram for block A	Free-body diagram for block B	Free-body diagram for block C
•	•	•

B. [4pts] In the spaces at right, draw a vector that represents the *net force* on each block. Make sure your vectors are drawn with correct relative magnitudes. Explain how you knew to draw the net force vectors as you did.

Net force on Block A	Net force on Block B	Net force on Block C

C. [12pts] Suppose the mass of block B were doubled (the other blocks are left unchanged) and the hand pushes with the ***same force*** as in part A.

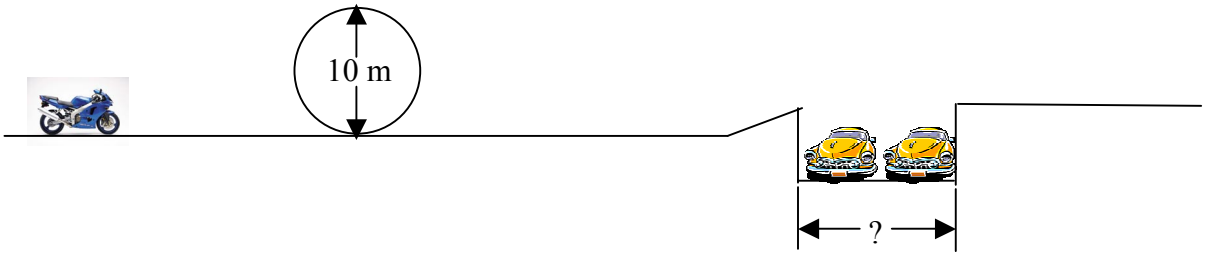
i. Has the *magnitude* of the acceleration of block A *increased, decreased,* or *remained the same?* Explain.

ii. Has the *magnitude* of the net force on block A *increased, decreased,* or *remained the same?* Explain.

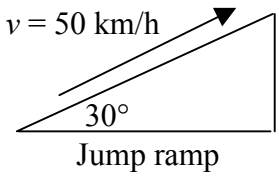
Problem 5 (20 points)

A friend of yours is building some apparatus for some performers for the county fair next year. One performer is a motorcycle rider. She wants to do a vertical loop the loop and jump several cars.

A. If she starts on level ground, assuming she travels at constant speed through the loop, what is the minimum speed (in kilometers per hour) the motorcyclist needs to go through the 10 m diameter loop without crashing?



B. After the loop, the motorcyclist wants to jump cars placed between two ramps as shown above. The left hand ramp, the jump ramp, is tilted at an angle of 30° to the horizontal (see below). Assuming the motorcycle goes up the jump ramp at 50 km/h, how far away should the landing on the right hand side be placed so the rider can jump the maximum number of cars placed in a pit between the jump ramp and the landing? Note that the vertical height of the landing is the same as where the car leaves the jump ramp.



Jump ramp

Group Test 3 (25 points) Physics 2048

As a concerned citizen, you have volunteered to serve on a committee investigating injuries to Junior High School students participating in sports programs. Currently your committee is investigating the high incidence of ankle injuries on the basketball team. You are watching the team practice, looking for activities that can result in large horizontal forces on the ankle. Observing the team practice jump shots gives you an idea, so you try a small calculation. A 40-kg student jumps 1.0 meters straight up and shoots the 0.80 kg basketball at his highest point. From the trajectory of the basketball, you deduce that the ball left his hand at 30 degrees from the horizontal at 20 m/s. What is his horizontal velocity when he hits the ground?

- USE THE GOAL PROTOCOL AND GROUP ROLES TO SOLVE THIS PROBLEM
- Make sure everyone's name and their group role on the GOAL Answer sheets
- WORK ONLY WITH YOUR GROUP MEMBERS
- NO BOOKS OR NOTES ALLOWED
- YOU WILL BE GRADED ON YOUR REASONING AND HOW WELL YOU USED THE GOAL PROTOCOL IN ADDITION TO THE CORRECTNESS OF YOUR ANSWER
- **YOU MUST START FROM GENERAL PHYSICS PRINCIPLES, I.E. KINEMATIC EQUATIONS, NEWTON'S SENCOND LAW, ETC.**