

SAMPLE TEST 4  
PHYS 111 SPRING 2011

Name: \_\_\_\_\_

*By writing my name above, I affirm that this test represents my work only, without aid from outside sources. In all aspects of this course I perform with honor and integrity.*

SHOW YOUR WORK ON ALL OF THE PROBLEMS — YOUR APPROACH TO THE PROBLEM IS AS IMPORTANT AS (IF NOT MORE) IMPORTANT THAN) YOUR FINAL ANSWER.

- 1) Derive the equations for the final velocities of particles undergoing an elastic collision in 1 dimension.

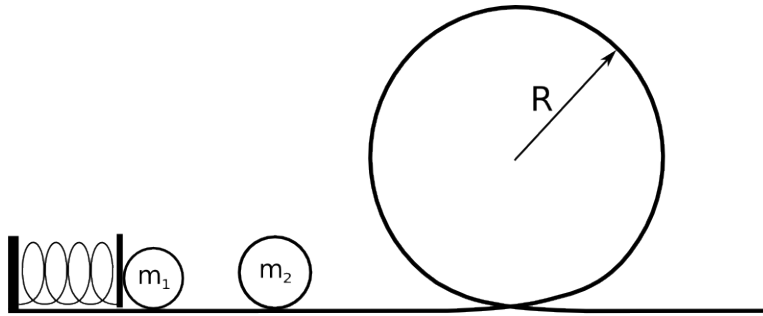
SAMPLE TEST 4  
PHYS 111 SPRING 2011

- 2)
- 2.1 When you fire a rifle, the bullet flies out and the rifle recoils. The magnitude of the momentum of the bullet is \_\_\_\_\_ the momentum of the rifle.
- greater than
  - the same as
  - less than
- 2.2 When you fire a rifle, the bullet flies out and the rifle recoils. Assuming that the bullet weighs less than the rifle, the Kinetic Energy of the bullet is \_\_\_\_\_ the Kinetic Energy of the rifle.
- greater than
  - the same as
  - less than
- 2.3) According to Newton's Second Law for systems of particles, if the sum of the external forces is zero:
- The position of the center of mass must be constant
  - The velocity of the center of mass must be zero
  - The velocity of the center of mass must be constant.
  - None of the above statements is true.
- 2.4) Which of the following systems do **NOT** conserve momentum?
- While slipping on a patch of ice a car collides with another car on the ice. (Ignore friction with the ice.)  
*System: Both cars.*
  - A single car sliding across the ice. (Ignore friction with the ice.) *System: The car.*
  - A ball drops to earth. (Ignore air friction.) *System: The ball.*
  - A billiard ball collides with another billiard ball on a pool table. (Ignore friction with the table during the collision.) *System: Both balls.*
- 2.5) Two friends are standing on opposite ends of a canoe. The canoe is initially at rest with respect to the lake. The person on the right throws a very massive ball to the left and the person on the left catches it. After the ball is caught, the canoe is (ignore friction between the canoe and the water)
- stationary
  - moving to the right
  - moving to the left.

SAMPLE TEST 4  
PHYS 111 SPRING 2011

3) In the system below, a ball of mass  $m_1$  is placed against a spring with spring constant  $k$  that has been compressed a distance  $d$ . It is released from rest and collides with a second ball of mass  $m_2$  which then goes around the loop the loop of radius  $R$ .

Find an expression for the minimum spring compression  $d$  in terms of  $m_1$ ,  $m_2$ ,  $k$ ,  $R$ , and  $g$  such that  $m_2$  makes it around the loop.



SAMPLE TEST 4  
PHYS 111 SPRING 2011

4. In many classic westerns, gunfighters fly backwards several meters after being shot, often crashing through windows or saloon doors. Assume that a typical bullet weights 2 g and that a typical cowboy weights 80 kg.

- a) If the bullet leaves the gun at 200 m/s, what is the velocity of the cowboy/bullet system after the impact?
- b) What velocity does the bullet need for the cowboy to slide 3 meters across the floor after being shot (assuming  $U_k = 0.5$ )?



SAMPLE TEST 4

PHYS 111 SPRING 2011

5. 4. A gun is mounted on a railroad car as shown in the picture. There is no friction between the car and the track, the track is perfectly horizontal, and the car is initially at rest. The gun fires a shell of mass 30 kg with a velocity of 300 m/s at an angle of  $40^\circ$  with respect to the horizontal. The mass of the railroad car is  $6 \times 10^4$  kg. What is the recoil velocity of the car?

