General Physics
Physics 101
Test #3 – Spring 2011
Friday 4/8/11
Prof. Bob Ekey

Name (print):_____

I hereby declare upon my word of honor that
I have neither given nor received unauthorized
help on this work.

Signature:_____

Part I. Multiple Choice (3 pts each)

Instructions:

Please clearly circle one and only one answer for each of the following.
Show all of your work. Partial credit may be given if you include your work.

Questions:

1. A 1.5 kg box is sliding on a frictionless surface with a speed of 12 m/s approaches a horizontal spring. If the spring has a spring constant of 2000 N/m, how far will the spring be compressed in stopping the box?

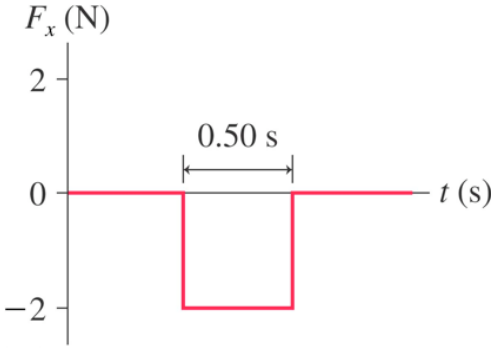
(a) 0.94 m
(b) 0.11 m
(c) 0.28 m
(d) 0.33 m

2. A ball on a string spins with a constant tangential speed. If you halve the radius of the string while halving the tangential speed, the centripetal force will be…

(a) Twice the original centripetal force
(b) Half the original centripetal force
(c) The same as the original centripetal force
(d) One quarter the original centripetal force

3. Three identical train cars, coupled together are rolling east at 2.0 m/s. A forth car traveling east at 4.0 m/s catches up with the three and couples to make a four car train. A moment later, the four-car train hits a fifth car that was at rest on the tracks and it couples to make a five-car train. What is the speed of the five-car train?

(a) 2.0 m/s
(b) 10 m/s
(c) 2.5 m/s
(d) 6.0 m/s



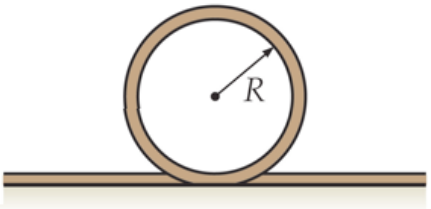
4. A 2.0 kg object is moving to the right with a speed of 1.0 m/s when it experiences the force shown. What impulse does the object experience?

(a) -1.0 kg m/s
(b) 0.50 Ns
(c) -0.50 Ns
(d) 0.0 Ns

5. A 2.0 kg slab of bacon has been taken by the I hate Bacon Club of America™, who have decided to destroy the slab by explosion to demonstrate the effects of eating too much of this glorious food. The slab is initially at rest post explosion splits into 3 pieces all traveling at the same speed, a 1.0 kg piece travels north and a 0.5 kg piece travels south, in what direction does the 3rd piece travel? The pieces were yummy.

(a) North
(b) The 3rd piece does not move
(c) South
(d) Unable to determine

6. A 1.00 kg ball approaches a loop-da-loop with a radius of 0.500 m. If at the top of the loop the normal force on the ball equals twice the gravitational force, what is the magnitude of the centripetal force?



(a) 9.80 N
(b) 19.6 N
(c) 29.4 N
(d) -9.80 N

7. A 50 g red marble moving at 2.0 m/s strikes a 20 g blue marble at rest. What is the speed of the blue marble immediately after the elastic collision?

(a) 2.9 m/s
(b) 1.1 m/s
(c) 1.4 m/s
(d) 0.86 m/s

8. For the following frictionless track, a ball is released from rest at the position shown. To what point does the ball make it right before reversing direction and rolling back? Position B is the same height as the starting position

(a) A
(b) B
(c) C
(d) Need more information.

9. A 1.0 kg ball on the end of a 2.0 m long string spins in a horizontal circle and the tension in the string is 10 N. What is the angular speed of the ball?

(a) 20 rad/s
(b) 4.5 rad/s
(c) 5.0 rad/s
(d) 2.2 rad/s

10. Two cars, one twice as heavy as the other, are at rest on a horizontal track. A person pushes each car for 5s. Ignoring friction and assuming equal force exerted on both cars, the momentum of the light car after the push is _____ the momentum of the heavy car.

(a) smaller than
(b) equal to
(c) larger than
(d) not able to be compared to

11. Two carts of equal mass but opposite velocities approach each other for a head-on elastic collision. Which of the following statements is false?

(a) Kinetic energy is conserved in this collision.
(b) The total momentum of the system is zero.
(c) After the collision both carts are at rest.
(d) The carts recoil in opposite directions.

12. A Frisbee is stuck 16.0 m above the ground in a tree. To dislodge the Frisbee you have to hit it with a rock traveling at 5.00 m/s. If you release the 0.500 kg rock 2.00 m above the ground, with what minimum kinetic energy must you throw it with?

(a) 68.6 J
(b) 72.3 J
(c) 78.3 J
(d) 74.9 J

Part II. Short answer problems (12 pts each)

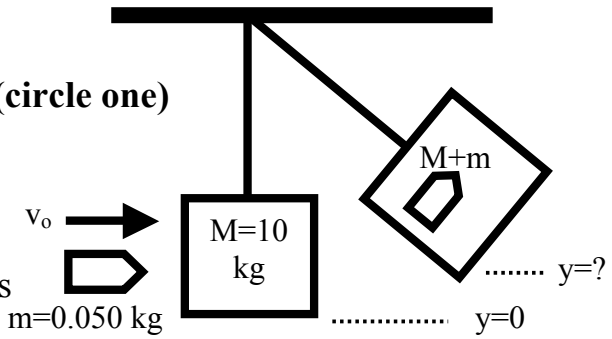
Instructions:

Solve three of the following four problems. If you try to solve all four problems, please clearly indicate which problems you wish to have graded. If you do not indicate this, I will assume you want me to grade problems one, two and three.

Please show all of your work, including equations without numbers.
Please provide units with all answers.
Partial credit may be given if you include your work.

Question 1. Grade this problem? Yes or No (circle one)

A 0.050 kg bullet is shot horizontally at a velocity of 200 m/s into a piece of 10 kg wood that hangs from a string attached to the ceiling. The block is initially motionless and after impact the bullet sticks in the block and they swing to an unknown height.



(a) Using momentum conservation, determine the velocity of the system (block +bullet) immediately after impact.

(b) Using energy conservation, determine the max height to which the system swings.

(c) At this max height, the string breaks and the block begins fall to the ground 3.0 m below. Use energy conservation to find the final velocity (mag. + dir.) of the block before it strikes the ground? Assume the initial velocity of the block is zero.

(d) During the impact, which was greater the change in momentum of the block or the earth? Words and justification are required, but no calculations are necessary.

Question 2. **Grade this problem? Yes or No (circle one)**

While at the county fair, you decide to ride the Ferris Wheel, which keeps you upright the entire motion while spinning at a constant angular speed. You estimate the diameter of the big wheel to be 30 m and determine that each loop around takes 25 s.

(a) What is the magnitude of your tangential speed as you ride the Ferris Wheel?

(b) When at the top of the motion, draw a force diagram showing all forces acting on you including the net force.

(c) Calculate the magnitude of the normal force you (50 kg) experience at the top of the motion.

(d) If you were to suggest a modification, where a rider would feel "weightless" at the top of the motion (normal force = zero), with what angular velocity would the Ferris Wheel have to spin?

Question 3. **Grade this problem? Yes or No (circle one)**

A vertical spring is standing on the ground. You are holding a 5.0 kg block just above the spring, not quite touching it. You suddenly let go of the block and it compresses the spring a distance of 0.20 m.

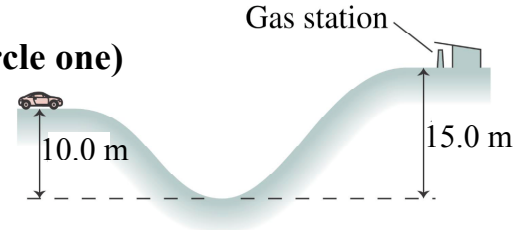
(a) What is the spring constant of the spring?

(b) Instead of dropping the block, you slowly lower the block to the point where you can remove your hand without disturbing it. How far would the spring be compressed?

(c) Explain why your two answers are different and/or the same in (a) and (b). Words and theory are necessary in your explanation, but no additional math is required.

(d) Bored with playing the spring, you decide to throw the 5.0 kg block with a velocity of 3.0 m/s at a 10.0 kg block which is initially motionless. Assuming they collide elastically, what is the velocity (magnitude and direction) of the 5.0 kg block immediately following the collision?

Question 4. **Grade this problem? Yes or No (circle one)**



A 1500 kg car traveling at 10.0 m/s suddenly runs out of gas while approaching the valley shown. Ignore Friction.

(a) What is the speed of the car at the bottom of the hill?

(b) Discuss the normal force acting on the car at the bottom of the hill, and whether it is greater than or less than the weight of the car. Words are necessary in your answer, and calculations and a force diagram could help but are not required.

(c) What will be the car's kinetic energy as it coasts into the gas station on the other side of the valley?

(d) What momentum will the car have as it coasts into the gas station?