General Physics
Physics 101
Test #3 – Fall 2012
Friday 11/16/12
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. In deep space, a mischievous astronaut decides to push another astronaut from behind. If both are initially at rest which of the following is not a possible scenario after the push?

(a) One astronaut travels off at a larger speed than the other.

(b) Both astronauts travel off with the same speed in opposite directions

(c) One astronaut is at rest after the push

(d) Both astronauts have the same magnitude of momentum.

2. The left end of a spring is attached to a wall. When Bill pulls on the right end with a 200 N force, he stretches the spring by 20 cm. The same spring is then used for a tug-of-war between Bill and Carlos. Each pulls on his end of the spring with a 200 N force. How far does the spring stretch now?

(a) 10 cm
(b) 20 cm
(c) 40 cm
(d) 80 cm

3. A cart is moving at 6.00 m/s when a 100 kg man drops vertically onto the cart. After the collision the man and cart move with a velocity of 2.00 m/s. What is the mass of the cart?

(a) 150 kg
(b) 100 kg
(c) 50.0 kg
(d) 75.0 kg

4. You are spinning 1.0 kg of water vertically in a bucket. Your arm has a radius of 0.75 m, and the bucket spins at a constant 5.0 rad/s. What is the normal force exerted on the water by the bucket when the bucket is at the top of its motion?

(a) 24 N
(b) 9.0 N
(c) 28 N
(d) 19 N

5. A truck and a compact car are traveling with identical momentums. If you want to stop both in the same amount of time, how do the forces needed to stop them compare?

(a) It takes a larger force to stop the truck.
(b) Both take the same force to stop.
(c) It takes a larger force to stop the car.
(d) Need more information.

6. A 100g ball moving to the right at 4.0 m/s catches up and collides with a 400 g ball that is moving to the right at 1.0 m/s. If the collision is perfectly elastic, what is the speed and direction of the 100 g ball after the collision?

(a) 0.80 m/s
(b) -2.2 m/s
(c) 1.6 m/s
(d) -8.0×10^{-1} m/s

7. A baseball player swings his 1.0 kg bat with a speed of 10 m/s, and hits a 60 g baseball that was approaching him at a speed of 20 m/s. If the ball rebounds at 40 m/s, what is the velocity of the bat immediately after the hit?

(a) 0.0 m/s
(b) 8.8 m/s
(c) 11 m/s
(d) 6.4 m/s

8. Two balls are of equal mass are being spun in a circle with constant speeds. If, ball A spins with twice the speed but with half the radius of ball B, what is the ratio of the centripetal force of ball A to ball B?

(a) 8 to 1
(b) 4 to 1
(c) 2 to 1
(d) 1 to 4

9. A safe is 2.0 m above a heavy-duty spring ($k=2.0 \times 10^5$ N/m) when the rope holding the safe breaks. The safe hits the spring and compresses it by 50 cm. What is the mass of the safe?

(a) 1020 m
(b) 1.0×10^4 kg
(c) 1.0×10^3 kg
(d) 1.3×10^3 kg

10. A 2.0 kg cart is traveling with -10 Ns of momentum. What is the kinetic energy of the cart?

(a) 25 Nm
(b) 5.0 Ns
(c) 1.0×10^2 J
(d) -25 J

11. Which of the following statements is false for a particle undergoing uniform circular motion.

(a) The velocity of the object is not constant.
(b) The object is experiencing a centripetal force.
(c) The object is experiencing a radially inward force.
(d) The object is in equilibrium.

12. On a loading dock, a 10 kg box is launched up a long ramp with an initial velocity of 10 m/s. What is the velocity of the box when it has traveled a vertical distance of 3.0 m? The angle of the ramp is 30º and assume there is no friction.

(a) 6.4 m/s
(b) 7.7 m/s
(c) 13 m/s
(d) The box never makes it to the top of the ramp

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)**

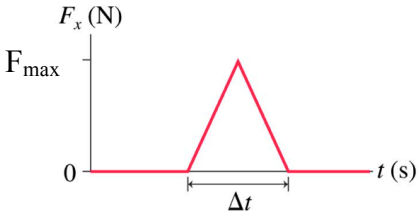
A block (m=1.0 kg) slides down a frictionless ramp and collides with a block that is twice as massive.

(a) Right before the collision with the twice as massive block, what is the speed of the mass, m?

(b) If the blocks bounce off one another, what is the velocity of the "2m" block post collision?

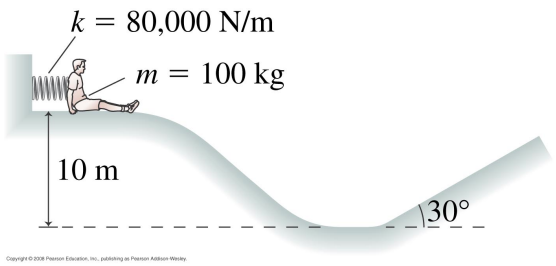
(c) Explain whether or not the magnitude of the "2m" blocks change in momentum is smaller, larger or the same as the momentum change as the "m" block. Words and possibly equations are necessary in your calculation, but no new calculations are necessary.

(d) If the impulse lasted for $\Delta t = 3.0$ ms as shown, what is the maximum force experienced by the "2m" block?



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

A spring is compressed 50 cm and used to launch a 100 kg physics student. Ignore friction.



(a) Determine the total mechanical energy of the system prior to launch. Define the bottom of the hill as zero vertical height.

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

(c) Determine the velocity of the man when he is at the bottom of the ramp.

(d) The man begins to ascend the ramp. When his velocity is half the value found at the bottom of the ramp in (c), what is his gravitational potential energy?

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

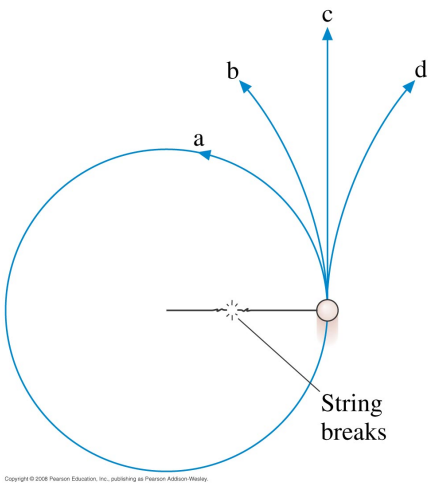
A 400 g ball on a 2.00 m long string is swung in a vertical circle

(a) What is the critical angular speed for this configuration?

(b) If you spin it with twice the critical angular speed (assumed to be constant), what is the net force applied to ball when it is at the bottom of the vertical circle? Explicitly state the direction that the force acts.

(c) What is the tension in the string when the ball is at the bottom of the vertical circle? A net force equation is required for full credit.

(d) Unfortunately, the string breaks when it was parallel to the ground and the ball is moving up. Which of the trajectories does the ball follow? Explain your answer with words and possibly equations. Calculations are not necessary.



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

A 20g ball of clay traveling west at 3.0 m/s collides with a 30g ball of clay traveling south at 2.0 m/s.

(a) What is the velocity of the combined 50 g ball of clay in the x-direction after the collision?

(b) What is the velocity of the combined 50 g ball of clay in the y-direction after the collision?

(c) At what angle is the 50 g ball of clay traveling post-collision?

(d) In this collision is momentum or kinetic energy conserved? Explain your answer using words, and be sure to address both momentum and kinetic energy.