General Physics
Physics 101
Test #3 – Spring 2012
Friday 4/4/12
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.

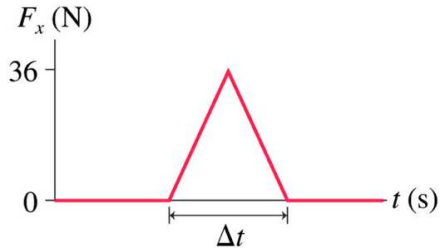
Signature:_____

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. If a block experiences an impulse of 0.036 Ns as shown, how long did the collision take?

(a) 1.0×10^{3} s
(b) 0.50 ms
(c) 2.0×10^{-3} s
(d) 1.0 ms

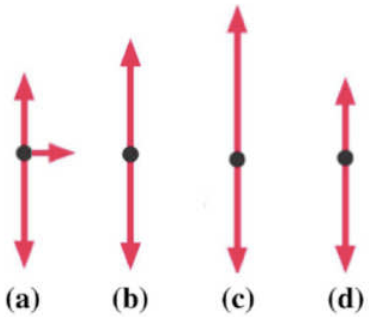
2. A 0.50 kg block is lowered gently on vertical spring with a spring constant of 75 N/m. If the spring's initial length is 10 cm, by how much has the spring stretched from its initial length?

(a) 0.006667 m
(b) 0.065 m
(c) 6.7 mm
(d) 15 cm

3. A 100 kg bumper car is traveling to the left with a speed of 4.00 m/s and collides elastically with a 200 kg bumper car that is initially at traveling at -2.00 m/s. What is the speed of the 200 kg car post collision?

(a) 2.00 m/s
(b) -4 m/s
(c) 3.33 m/s
(d) -2.67 m/s

4. A car runs out of gas just before the top of a hill. It rolls over the top of the hill and starts down the other side. At the very top of the hill, which of the free-body diagram is correct? Friction and drag force are negligible.



5. A 620 g bird has a 60 g stick in its mouth (680 g total) that is coasting in the air horizontal to the ground at 30 m/s. If the bird releases the 60 g stick, what is the bird's velocity just after the stick leaves the bird's mouth.

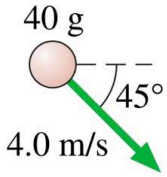
(a) 30 m/s
(b) 33 m/s
(c) 3.4 x 10^2 m/s
(d) 27 m/s

6. If you spin a 0.50 kg ball on the end of a 2.0 m long string in a horizontal circle with twice the critical speed. What is the tension in the string?

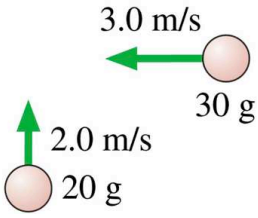
(a) 9.8 N
(b) 4.9 N
(c) 8.8 N
(d) 96 N

7. You throw a ball straight up in the air with an initial speed v and the ball reaches a maximum height, h. If you want to reach a height of 2h, at what initial what initial speed do you have to throw the ball?

(a) 0.5v
(b) $\sqrt{2}$ v
(c) 2v
(d) 4v



8. Three balls of clay are traveling as shown and hit simultaneously and stick together. What is the net momentum in the y direction after the collision?



(a) 0.022 Ns
(b) -0.022 kg m/s
(c) -0.073 kg m/s
(d) 0.15 kg m/s

9. A huge spring-loaded launcher has a spring constant of 5000 N/m, which is compressed a distance of 1.00 m. A 1.00 kg ball is launched horizontally from the spring. During the launch, when the spring is compressed by 0.50 m, what is the velocity of the ball?

(a) 71 m/s
(b) 35 m/s
(c) 50 m/s
(d) 61 m/s

10. Which of the following statements is true?

(a) In a conservative system, the total mechanical energy can change.

(b) It is possible to have a collision between two objects where only one is moving before but neither is moving after.

(c) The kinetic energy of an object does not depend on the direction the object is traveling.

(d) The net force acting on an object in uniform circular motion is zero.

11. A block of mass 1.0 kg slides from rest down an incline falling through a vertical distance of 2.0 m. At the bottom of the ramp, the block collides with a mass 2.0 kg in an inelastic collision. What is the momentum of the system after the collision?

(a) 6.3 Ns
(b) 2.6 kg m/s
(c) 3.1 Nm
(d) 9.3 kg m/s

12. As you turn a 50 m radius corner in your car, you continue to move forward and as the car turns, you strike the door. As you are now a "scholar" of physics, you know that the force required to turn you is 100 N, and your mass is 75 kg. With what angular speed were you traveling as you were experiencing this force?

(a) 0.0 rad/s
(b) 0.027 m/s
(c) 8.2 rad/s
(d) 0.16 rad/s

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)

In lab, you launched a 500 g cart up the hill and the pre-launch position was defined as zero vertical distance. Ignore friction and air resistance.

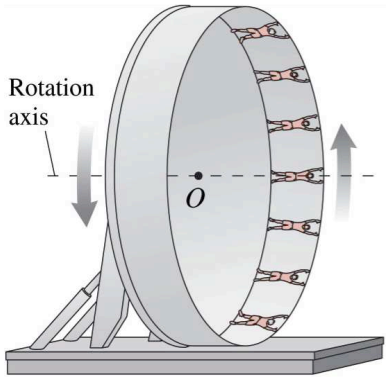
(a) When the cart was at a vertical distance of 10 cm, the velocity was measured to be 1.0 m/s. What is the total mechanical energy in the system?

(b) Explain what happens to the gravitational energy, kinetic energy and total mechanical energy as the cart moves up the hill. Are they increasing, decreasing or remaining constant? Words and equations are necessary in your explanation, but no further calculations are required.

(c) How far vertically up the ramp did the cart travel from the launch point before turning around?

(d) If the spring used to launch the cart was compressed by 5.5 cm, what is the spring constant of the spring?

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



In an amusement park ride called "The Roundup", passengers stand inside a 16-m diameter rotating ring. After the ring has acquired sufficient speed, it tilts into a vertical plane.

(a) Suppose the rider's mass is 55 kg and they rotate at a constant speed of 11 m/s. What is the magnitude and direction of the net force when the rider is at the top of the ride? Please explicitly state direction.

(b) With how much force does the ring push on her at the bottom of the ride?

(c) Looking at the top of the motion, what happens to the forces acting on her if the ride were to approach the critical speed? Words and a net force equation are necessary. A force diagram could help. No calculations are necessary.

(d) What is the critical speed that will prevent the riders from falling off at the top?

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

A 2.00 kg block initially at rest explodes into two pieces.

(a) If the 1.50 kg piece of block travels away at +2.0 m/s, what is the velocity (mag + dir) of the 0.50 kg piece of block?

(b) The 1.50 kg block collides with the wall and comes to rest. What was kinetic energy or momentum conserved in this collision? Explain/justify your answer with words and possibly equations. Be sure to answer yes or no for each.

(c) You now want to stop the 0.50 kg block by firing a bullet at it in the opposite direction. The 50 g bullet is initially traveling at 400 m/s, and it strikes the block causing it to stop, but the bullet continues through. What is the velocity of the bullet after leaving the 0.50 kg block?

(d) Calculate the impulse applied to the bullet during this collision, be sure to state the direction of the impulse.

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

A 500 g rubber ball is dropped from a height of 10 m.

(a) What is the velocity of the ball right before it strikes the ground?
Please use energy conservation to solve this.

(b) If the elastic collision between the 5.98×10^{24} kg earth and the ball, what is the velocity of the ball post-collision? Assume the earth was at rest initially.

(c) Explain whether or not the magnitude of the earth's change in momentum is smaller, larger or the same as the momentum change as the ball. Words and possibly equations are necessary in your calculation, but no new calculations are necessary.

(d) What was the average force (magnitude and direction) exerted on the ball during the collision, assuming the contact time was 1.0 ms.