General Physics
Physics 101
Test #3 – Fall 2010
Friday 11/19/10
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 20 g particle is moving to the left at 30 m/s and an impulse is applied that causes the particle to switch direction and move to the right at 30 m/s.
What is the change in kinetic energy of the particle?

(a) 0.0 J
(b) 9.0×10^3 Ns
(c) 18 Nm
(d) 36 kg m/s

2. You're playing tee-ball where the 0.15 kg ball is initially at rest and after the hit the velocity of the ball is 20 m/s. If the 1.0 kg bat had velocity of 10 m/s before impact, the velocity of the bat after impact should be…

(a) greater than the initial velocity of the bat.
(b) less than the initial velocity of the bat.
(c) the same as the initial velocity of the bat.
(d) not able to be determined from the information given.

3. A 1.0 kg rock is attached to a string with a radius of 2.0 m. You spin the rock above your head in a nearly horizontal circle. If the string breaks when a tension of 50 N is applied, what minimum speed of the rock is necessary to break the string?

(a) 5 m/s
(b) $\sqrt{10}$ m/s
(c) 10 m/s
(d) 100 m/s

4. You and a friend are playing with air-hockey pucks (all 1D). You send the 1.0 kg puck with a velocity of 1.0 m/s and your friend sends the 2.0 kg puck in the opposite direction with a velocity of -2.0 m/s. Assuming the pucks bounce off each other, what is the speed of the 2.0 kg puck following the collision?

(a) 3.0 m/s
(b) 1.3 m/s
(c) 1.0 m/s
(d) 0.0 m/s

5. Particle B has half the mass and eight times the kinetic energy as particle A. What is the speed ratio v_B to v_A?

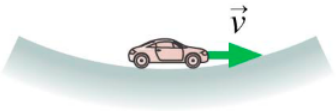
(a) 4 to 1
(b) 32 to 1
(c) 1 to 4
(d) 2 to 1

6.Suppose a ping-pong ball and a bowling ball are rolling toward you. Both have the same momentum, and you exert the same force to stop each. How does the time needed to stop them compare?

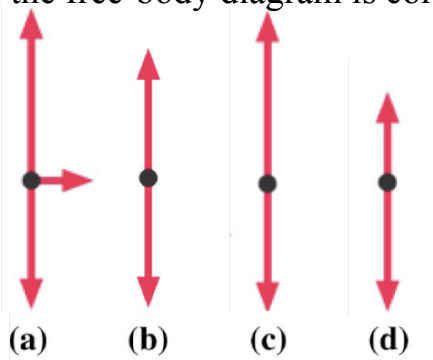
(a) It takes a longer time to stop the ping-pong ball.
(b) Both take the same time to stop.
(c) It takes a shorter time to stop the ping-pong ball.
(d) Need more information.

7. A 1.0 kg Barbie is connected to a multi-rubber-band "spring" and dropped from a vertical distance slightly over 4.0 m from the floor. For Barbie not hit the floor, the "spring" must stretch 1.5 m in length. What is the total spring constant for the rubber bands, assuming they obey Hooke's law?

(a) 6.5 Nm
(b) 1.6 N/m
(c) 52 N/m
(d) 35 N/m



8. A car runs out of gas while driving down a hill. It rolls through the valley and starts up the other side. At the very bottom of the valley, which of the free-body diagram is correct? Friction and drag force are negligible.



9. A 5.0 kg blob and a 4.0 kg blob approach each other with velocities of 2.0 m/s and -3.0 m/s respectively. If the collision is inelastic, what is the blob's final velocity?

(a) 2.4 m/s
(b) 0.77 m/s
(c) -2.4 m/s
(d) -0.22 m/s

10. A coconut initially at rest spontaneously explodes into three pieces. If the first piece travels to the north with a momentum of 100.0 kg m/s and the second piece travels to the west with 50 kg m/s, what is the magnitude and general direction of the third piece's momentum following the explosion?

(a) 111.8 kg m/s to the north & west.
(b) 150.0 kg m/s to the south & east.
(c) 1.1 x 10^2 kg m/s to the south & east.
(d) 1.5 x 10^2 kg m/s to the north & west.

11. You drop a 0.500 kg ball from a window 3.00 m above the ground. What is the velocity of the ball right before it strikes the ground?

(a) 58.8 m/s
(b) 8 m/s
(c) -5.42 m/s
(d) -7.67 m/s

12. You (70 kg) are riding a 30 m diameter Ferris wheel at an amusement park, which spins with a constant angular velocity of 0.25 rad/s. If the seats in the Ferris wheel remain upright during the ride, what is the magnitude of the normal force acting on you when you are at the top of the Ferris wheel?

(a) 5.5×10^2 N
(b) 7.5×10^2 N
(c) 6.9×10^2 N
(d) 6.2×10^2 N

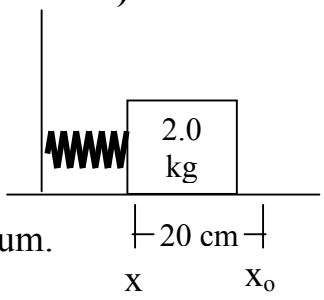
Part II. Short answer problems (12 pts each)

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)**

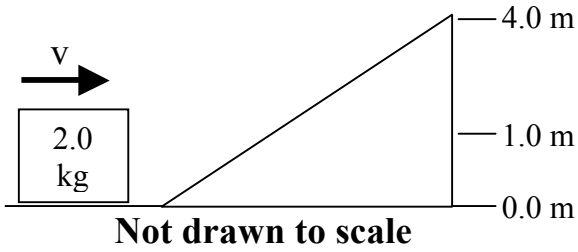


Since you have nothing better to do, you are playing with your spring-loaded cannon, which has a spring constant of 2000 N/m. You load the cannon with a 2.0 kg block, compressing the spring a distance of 20 cm from its equilibrium length.

(a) Calculate the force necessary to compress the spring from equilibrium.

The cannon is configured so it will fire horizontally onto a friction-free surface.
(b) After you fire the cannon, what is the velocity of the mass as it leaves the cannon?

(c) The block traveling at the same velocity as (b) now approaches a friction free ramp (as shown). After it has climbed a 1.0 m vertical distance, what is the block's kinetic energy?



Not drawn to scale

(d) Would the block ever make it to a vertical height of 4.0 m? Explain/justify your answer with a calculation and words.

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

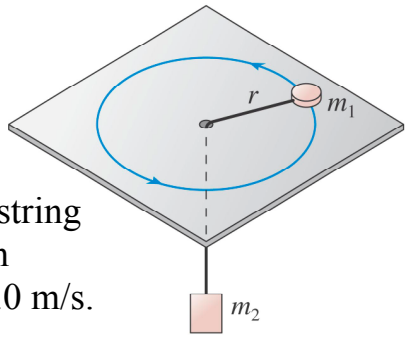
Car A (10 kg) is traveling at a velocity of 30 m/s towards Car B (20 kg), which is at rest. They collide and bounce away from each other (amazing bumpers) all in one dimension and elastic collisions. (Note: masses are small on purpose.)

(a) What is the final velocity of car A?

(b) What is the final velocity of car B?

(c) Explain which car has a greater change in momentum (magnitude).
Words are necessary and equations with calculations may help, but are not required.

(d) Assuming the elastic collision took 30 ms, calculate the average force applied to car A during the collision (magnitude and direction).



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

Mass m_1 = 10 kg on the frictionless table shown is connected by a string through a hole in the table to a hanging mass m_2 = 20 kg. When in operation m_2 remains motionless, while m_1 spins with a speed of 2.0 m/s.

(a) Draw a force diagram for this system showing all forces acting on m_1 and m_2. Net force equations are not necessary, but may help later.

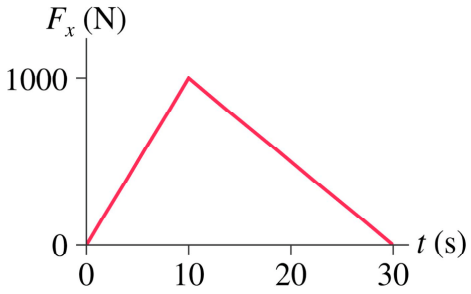
(b) Calculate the radius of the circle that m_1 creates.

(c) Calculate the rotational period of m_1?

(d) Is the system in equilibrium? Be sure to explain or justify your answer.

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

Space, the final frontier? Far in space, where gravity is negligible, a 425 kg rocket traveling at 75 m/s fires its engines. The graph provided shows the thrust force as a function of time. Assume the mass of the ship is constant.



(a) What total impulse does the engine impart to the rocket?

(b) Calculate the final velocity of the spaceship.

(c) At what time does the space ship reach its maximum velocity? Explain and justify your answer.

(d) What is the change in kinetic energy of the spaceship?