# General Physics
# Physics 101
# Test #3 – Spring 2014
# Friday 4/11/14
# 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 0.20 kg plastic cart and a 20 kg lead cart both roll without friction on a horizontal surface. Equal forces are used to push both carts forward for a time of 1s, starting from rest. After the force is removed at 1 s, the momentum of the plastic cart is _____ the momentum of the lead cart.

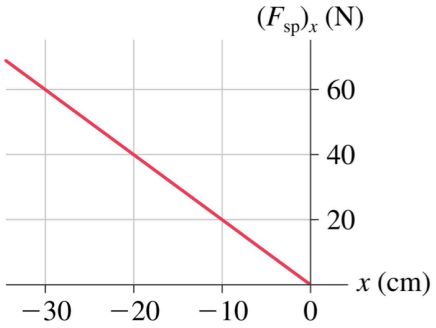
(a) greater than
(b) less than
(c) equal to
(d) not possible to compare

2. 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 speed 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

3. You are whirling a bucket of water in a vertical circle at a speed of 4.0 m/s and at a radius of 0.75 m. If the normal force exerted on the water is 2.0 N when it is at the top of its motion, what is the mass of the water in the bucket?

(a) 64 g
(b) 0.17 kg
(c) 94 g
(d) 0.91 kg




4. A 50 g rock is placed in a slingshot and the rubber band is stretched. The force of the rubber band on the rock is shown in the graph. What is the spring constant of the rubber band?

(a) – 200.0 N/m
(b) 2.0 Nm
(c) 25 $kgm^2/s$
(d) 2.0 x $10^2$ N/m

5. A 50 g ball on the end of a 2.0 m long string is spun uniformly in a horizontal circle and makes 4.0 revolutions per second. What centripetal force does the ball experience during this motion?

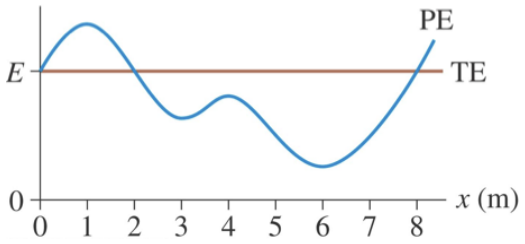
(a) 63 kg $m/s^2$
(b) 0.25 N
(c) 1.6 Nm
(d) 0.0 N

6. 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) 6.4 m/s
(d) 11 m/s

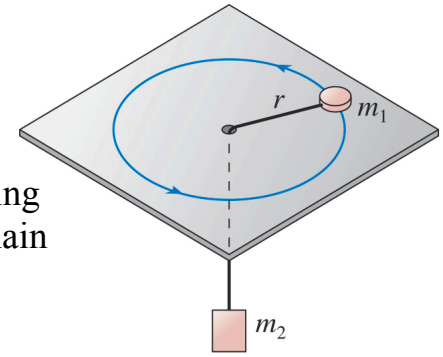
7. A boy reaches out of a window and tosses a 2.0 kg ball straight up with a speed of 10 m/s. If the ball is 20m from the ground as he releases it, what is the ball's impact velocity?

(a) -22 m/s
(b) 20.04 m/s
(c) -17 m/s
(d) -20 m/s




8. A particle with the potential energy (PE) shown is moving to the right at x=5 m with total energy "TE". At which point is the particle's speed the biggest?

(a) 1.0 m
(b) 3.0 m
(c) 4.0 m
(d) 6.0 m



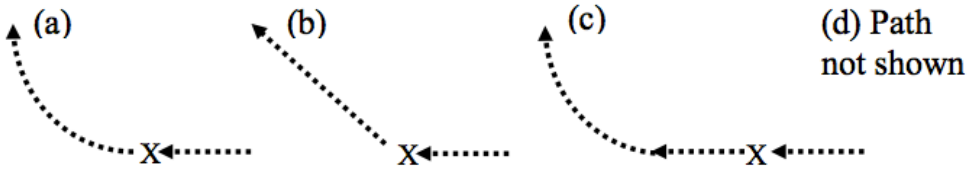

9. Mass $m_1$ on the frictionless table shown is connected by a string through a hole in the table to a hanging mass $m_2$. For $m_2$ to remain motionless, while $m_1$ spins with a speed v at radius r, which of the following is false?

(a) The system is not in equilibrium
(b) The tension in the string supplies a radially inward force on $m_1$
(c) The period of $m_1$ is constant
(d) The angular acceleration of $m_1$ is zero


10. A "2m" block slides down a frictionless ramp and collides with a block "m". The blocks collide and stick together, what is the speed of the blocks after the collision?

(a) 2.6 m/s
(b) 7.7 m/s
(c) 5.1 m/s
(d) 3.9 m/s

11. A hockey puck slides to the west at 1.0 m/s on a 2D horizontal (level) surface. A rocket on the puck is aimed to the north and is fired (X). Which of the following shows the path of the puck post-fire? Assume the rocket provides a constant thrust.




12. A 10-m long glider with mass of 680 kg (including the passengers) is gliding horizontally through the air at 30 m/s when a 60 kg skydiver drops out by releasing his grip on the glider (the glider + passengers remaining are 620 kg). What is the glider's velocity just after the skydiver lets go?

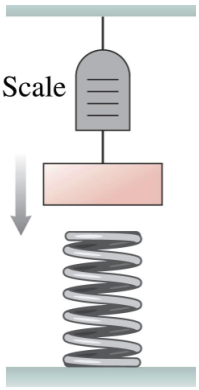
(a) 33 m/s
(b) 30 m/s
(c) 3.4 x $10^2$ m/s
(d) 27 m/s

# 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)**

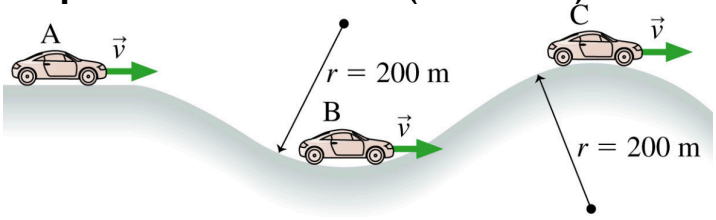
A scale measures the mass of an object to be 10.0 kg (98.0N).
(a) In your first experiment, you gently lower the object onto a spring (k=500 N/m) and read the scale. What is the reading on the scale in Newtons, when the spring is gently compressed by 10.0 cm?

You now setup for another experiment, but right before you touch the object to the spring, the object comes loose from the scale. You decide to watch what happens.
(b) What is the maximum compression of the spring as the object falls onto it?

For the third experiment, you turn the spring horizontally and launch the object, by compressing the spring by 50 cm.
(c) How fast is the object traveling when the spring is compressed by only 10 cm?

(d) If you compress the spring by twice as much as in (c) by what factor did the spring potential energy increase? Words and an equation are necessary, but no new calculations are required in your answer.

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




A 1000 kg car is driving over hills with the radius of curvature of each hill as shown. At the bottom of the hill (location B") the car's speed is 25 m/s.

(a) What is the magnitude of the normal force exerted on the car at the bottom of the hill (location B)?

(b) If the normal force experience by the car at the top of the hill (location C) is half the value found in (a), what is the net force (mag + dir) experienced by the car at the top of the hill (location C)?

(c) How fast is the car traveling at the top of the hill (location C)?

(d) If you wanted to drive as fast as you could over the top of the hill (location C) but not have the car leave the road, what happens to the forces acting on the car to cause the car to remain on the road? Words, diagrams and equations may help in your answer, but no new calculations are required.

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

A 6.0 kg block initially at rest on a flat level surface explodes into three pieces. The first piece (1.0 kg) travels off to the north, the second (2.0 kg) travels to the east and the third (3.0 kg) travels at a speed of 2.0 m/s at an angle of 30º south of west ($v_{3x}$=-1.7 m/s, $v_{3y}$=-1.0 m/s).

(a) What is the velocity of the first piece (1.0 kg) after the explosion?

(b) What is the velocity of the second piece (2.0 kg) after the explosion?

(c) What is the total kinetic energy of the system after the explosion?

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

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

Two 500 g blocks are 2.0 m apart on a frictionless table. A 10 g bullet is fired at 400 m/s towards the blocks. It passes all the way through the first block then embeds itself in the second block. The speed of the first block immediately afterwards is 6.0 m/s.

(a) What is the velocity of the bullet after it leaves the first block?

(b) What is the speed of the 2$^{nd}$ block after the bullet stops in it?

(c) If the bullet took 3.0 ms to come to rest, what impulse does the block experience during this collision? Be sure to indicate in what direction the impulse acts.

(d) The bullet embedded block slides off the table and falls to the floor. During the fall what is happening to the total mechanical energy, kinetic energy and gravitational potential energy? Are they increasing, decreasing or remaining constant? Words and equations are required in your justification, but calculations are not.