# General Physics
# Physics 101
# Test #3 – Fall 2011
# Friday 11/18/11
# 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 0.2 kg plastic cart and a 20 kg lead cart can both roll without friction on a horizontal surface. Equal forces are used to push both carts forward starting from rest. After 10 s the momentum of the lead cart is _____ the momentum of plastic cart.

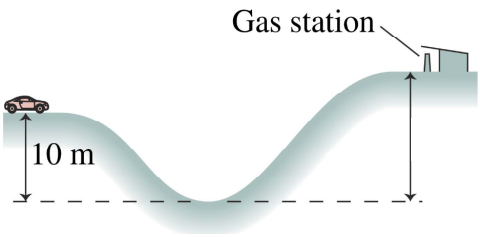
(a) less than
(b) greater than
(c) the same as
(d) not possible to compare, need more information.

2. A 2.0 kg mass on the end of a 1.5 m long string is spun in a vertical circle. If at the bottom of the motion tension in the string is 3.0 times the gravitational force, what is the magnitude of the centripetal force acting on the mass at this point in the motion?

(a) 20 N
(b) 39 N
(c) 59 N
(d) 78 N

3. 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) 30 m/s
(b) 33 m/s
(c) $3.4 \times 10^2$ m/s
(d) 27 m/s




4. A 1500 kg car traveling at 10.0 m/s suddenly runs out of gas while approaching the valley shown. If the car coasts into the gas station with a speed of 1.00 m/s, how high from the bottom of the valley is the gas station?

(a) 5.05 m
(b) 4.95 m
(c) 25 m
(d) 15 m

5. A 2000 kg car goes around a 20 m radius curve at a speed of 50 mph, what is the magnitude of the friction force acting between the rubber tires and the road

(a) $5.0 \times 10^4$ N
(b) $1.2 \times 10^6$ N
(c) $2.5 \times 10^5$ N
(d) Impossible to determine.

6. A spring-loaded gun shoots a plastic ball with a speed of 4 m/s.
If the spring is compressed twice as far, the ball's speed will be?

(a) 2 m/s
(b) 4 m/s
(c) 8 m/s
(d) 16 m/s

7. 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?

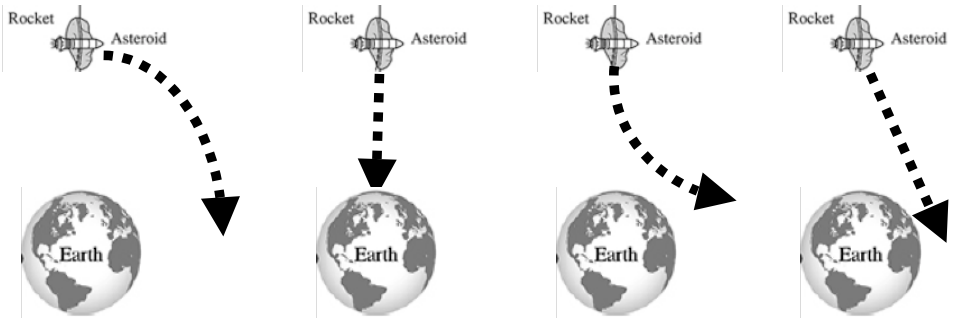
(a) 3.0 m/s
(b) 1.3 m/s
(c) 1.0 m/s
(d) 0.0 m/s

8. You fire a 50.0 g bullet into a 10.0 kg block of wood that sits on a slippery surface. The bullet leaves the gun with an initial speed of 300 m/s. The bullet and the block collide. If after the collision, the block has a velocity of 1.00 m/s, what is the velocity of the bullet after it leaves the block?

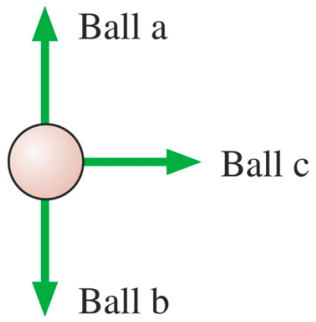
(a) (b) (c) (d)

(a) 300 m/s
(b) 100 m/s
(c) 200 m/s
(d) $3.0 \times 10^5$ m/s

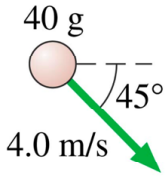
9. A rocket is attached to an asteroid that is heading towards earth. If the rocket fires continually with a constant force in a direction perpendicular to the initial direction of motion until it reaches the plane of the earth. Which shows the proper trajectory of the rocket/asteroid?



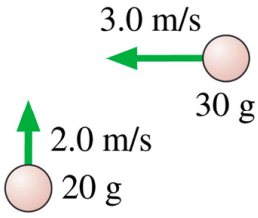

10. Three balls (a, b, c) which have equal masses are fired with speeds from the same height above the ground. Which has the largest kinetic energy when hitting the ground?




(a) Ball a
(b) Ball b
(c) Ball c
(d) They have the same Kinetic Energy.




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




(a) 0.022 Ns
(b) -0.022 kg m/s
(c) -0.073 kg m/s
(d) 0.20 kg m/s

12. Which of the following statements is true for a particle undergoing uniform circular motion.

(a) The net force on the object is zero.
(b) The object is experiencing a centripetal force.
(c) The object is experiencing a radially outward force.
(d) The speed of the object is not constant.

# 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)**

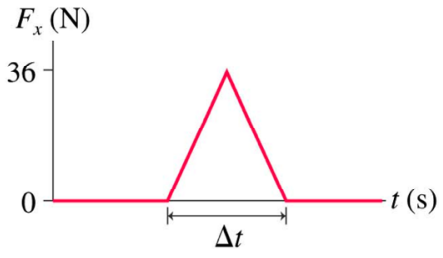
A 2.0 kg block is traveling to the right with a velocity of 3.0 m/s. The block collides with a stationary 1.0 kg block and the blocks bounce apart (elastic collision).

(a) What is the velocity of the 2.0 kg block post collision?

(b) What impulse does the 2.0 kg block experience?

(c) With no further calculations explain/justify whether the magnitude of the impulse experienced by the 1.0 kg block is greater than, the same as or less than the 2.0 kg block. Be sure to use words in your response.

(d) If during the collision, the force applied to the 1.0 kg block is as shown, how long did the collision take?



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

You are spinning a bucket of water vertically and the bucket is undergoing uniform circular motion. Initially, your arm has a radius of 1.00 m, and the bucket spins at a speed of 60.0 rpm.

(a) What is the period of one revolution of the bucket?

(b) Draw a force diagram showing all forces acting on the water when the bucket is at the top of its motion. Be sure to clearly label the net-force in the diagram.

(c) What is the normal force exerted on the water by the bucket when the bucket is at the top of its motion? Assume 1.00 kg of water.

(d) What is the minimum tangential speed the bucket can spin with without the water falling out of the bucket at the top of its motion?

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

A 0.500 kg Barbie™ Doll is dropped from the 2nd floor of Bracy into the lobby. In this first experiment, there is nothing attached to Barbie once she is released.

(a) Using energy conservation, determine the velocity (mag + dir) of Barbie™ prior to impact with the floor 5.0 m below.

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

(c) You now attach a series of rubber bands to Barbie™ and gently lower her down, and the rubber bands stretch a distance of 4.0 m. Assuming the rubber bands act like a spring, what is the spring constant for the system?

(d) You now throw Barbie™ from the 2nd floor with 25 J of initial kinetic energy and she hits the ground 5.0m below and her head falls off. How much total mechanical energy did the system have when it hit the ground?

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

A 1.0 kg block slides from rest down a frictionless slide attaining a speed of 3.0 m/s at the bottom.

(a) From what vertical height did the block slide?

Next you slide the same block down the same ramp, but at the bottom of the ramp is a stationary 2.0 kg block. The blocks collide and stick together.

(b) In the collision is momentum or kinetic energy conserved? Explain your answer.

(c) What is the speed of the combined blocks post-collision?

(d) The blocks now approach a horizontal spring and the spring is compressed bringing the blocks to rest. If the spring constant is 25 N/m, by how much is the spring compressed?