General Physics
Physics 101
Test #3 – Fall 2014
Friday 11/14/14
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.

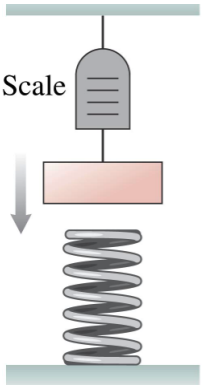
Signature:_____

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:

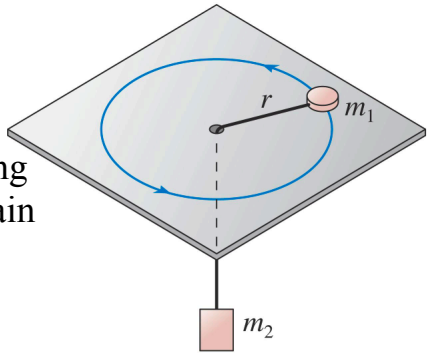


1. You gently lower a 20.0 kg object attached to a scale onto a spring (k=500 N/m). What is the reading on the scale in Newtons, when the spring is gently compressed by 10.0 cm?

(a) 50.0 N
(b) 146 N
(c) 246 N
(d) 196 N

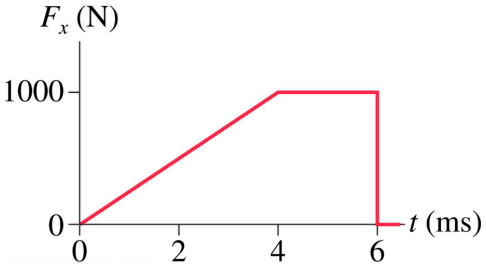
2. A 2.0 kg puck sliding to the left at 2.0 m/s, strikes a 1.0 kg stationary puck but does not bounce elastically. The pucks travels off separately with the 1.0 kg puck traveling at -1.0 m/s. What is the speed of the 2.0 kg puck after the collision?

(a) 1.5 m/s
(b) 2.5 m/s
(c) 3.0 m/s
(d) 1.3 m/s



3. 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 non-zero

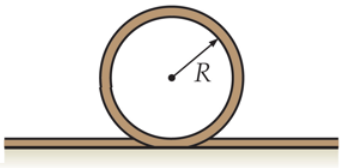


4. You throw your 1.0 kg book onto the table with a velocity of -1.0 m/s, and it experiences the force shown. What impulse does the book experience?

(a) -1.0 Ns
(b) 6.0 kg m/s
(c) 4.0 Ns
(d) 6.6 Nm

5. A 2.0 kg puck sliding to the left at 2.0 m/s, collides elastically with a 1.0 kg stationary puck. What is the speed of the 1.0 kg puck after the collision?

(a) 1.5 m/s
(b) 0.67 m/s
(c) 2.6 m/s
(d) 1.3 m/s

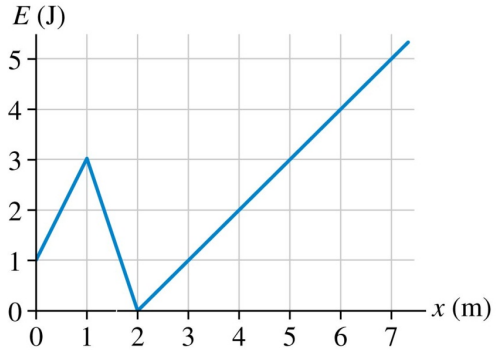


6. A 1.00 kg ball approaches a loop-da-loop with a radius of 0.500 m. If at the top of the loop the normal force on the ball equals twice the gravitational force, what is the magnitude of the centripetal force?

(a) 9.80 N
(b) 19.6 N
(c) 29.4 N
(d) -9.80 N

7. A 6.0 kg block initially at rest on a flat level surface explodes into three pieces. The 1.0 kg piece travels off to the north, the 2.0 kg piece travels to the east and the 3.0 kg piece 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). What is the velocity of the 2.0 kg piece after the explosion?

(a) 2.6 m/s
(b) 3.0 m/s
(c) 1.5 m/s
(d) 6.0 m/s



8. A particle with the potential energy shown is moving to the right. It has 1.0 J of kinetic energy at x=1.0 m. In the region 1.0 m<x< 2.0 m, the particle is

(a) speeding up.
(b) slowing down.
(c) moving at constant speed.
(d) impossible to determine.

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

(a) 1 m/s
(b) 2 m/s
(c) 4 m/s
(d) 8 m/s

10. You throw a ball downward at 1.6 m/s from the top bunk of your bed, 1.7 meters above the ground. What is the velocity of the ball right before impact?

(a) 5.989 m/s
(b) -5.5 m/s
(c) 4.3 m/s
(d) -6.0×10^{0} m/s

11. A 0.50 kg ball is spun in a horizontal circle at radius of 0.50 m and the tension in the string is 50 N. What is the angular velocity of the motion, assuming it is traveling at constant speed?

(a) 10 rad/s
(b) 7.1 rad/s
(c) 3.5 rad/s
(d) 14 m/s

12. A light plastic cart and a heavy steel cart are both pushed for 1.0 s, starting from rest. To have each cart achieve the same momentum after the forces are removed, the force on the plastic cart is _____ that of the heavy steel cart.

(a) greater than
(b) less than
(c) equal to
(d) not possible to determine without more information

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 being launched horizontally by a spring that is compressed by 20 cm. Pretend friction doesn't exist (lies).

(a) If the block leaves the spring traveling at 2.0 m/s, what is the spring constant?

The 2.0 kg block now approaches a 1.0 kg block that is stationary.
(b) If the blocks collide and stick together, what is their speed post collision?

The combined blocks now approach a frictionless ramp.
(c) How far up the ramp vertically have the blocks slid when its velocity is half of that in found in (b)?

(d) During (c) what is happening to the total mechanical energy, kinetic energy and gravitational potential energy of the blocks? Are they increasing, decreasing or remaining constant? Words and equations are required in your justification, but calculations are not.

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

A cannon in a pirate ship fires a 5.0 kg cannon ball towards an enemy ship. The ball leaves the cannon with a speed of 20 m/s an angle of 30° above the horizontal.

(a) In the firing of the ball is momentum and/or kinetic energy conserved? Explain your answer using words, and be sure to address both momentum and kinetic energy.

(b) If the ball missed the ship, how fast is the ball traveling right before it impacts the water 4.0 m below the launch point? Please use energy-conservation.

Another 5.0 kg cannon ball is launched horizontally at +20 m/s.
(c) If the 100 kg cannon is on wheels, what is its velocity after launch of the cannon?

(d) Immediately after leaving the 5.0 kg ball is leaving the cannon a 4.0 kg cannon ball traveling at -10 m/s collides with it. Assuming an elastic collision and all 1D (lies), what is the velocity of the 5.0 kg ball post collision?

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

You are whirling a bucket of water in a vertical circle in uniform motion. Assume your arm has a radius of 60 cm, and the water has a mass of 500 g. Also assume the mass of the bucket is negligible. At the bottom of the motion, the bucket exerts a normal force of 8.0 N (magnitude) on the water.

(a)What is the magnitude of the net force acting on the water at the bottom of the motion?

(b) With what tangetial speed is the bucket traveling?

(c) What is the normal force acting on the water when it is at the top of its motion? Be sure to explicitly indicate in what direction the normal force acts.

(d) If you wanted to spin the bucket as slow as possible but not have the water leave the bucket at the top of the motion, what happens to the forces acting on the water to cause it to remain in the bucket? Words are required in your answer and possibly diagrams and equations, but no new calculations are required.

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

Puck A (500 g) is traveling is traveling with -10 Ns of momentum in the x-direction.

(a) What is the kinetic energy of the puck?

(b) Puck B (250 g) travels with 20 Ns of momentum, which collides with puck A. If puck B travels off with -5.0 Ns of momentum, what is the final velocity of puck A?

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

(d) Assuming the collision took 5.0 ms, calculate the average force applied to puck A during the collision. Explicitly state whether the force is to the left or right.